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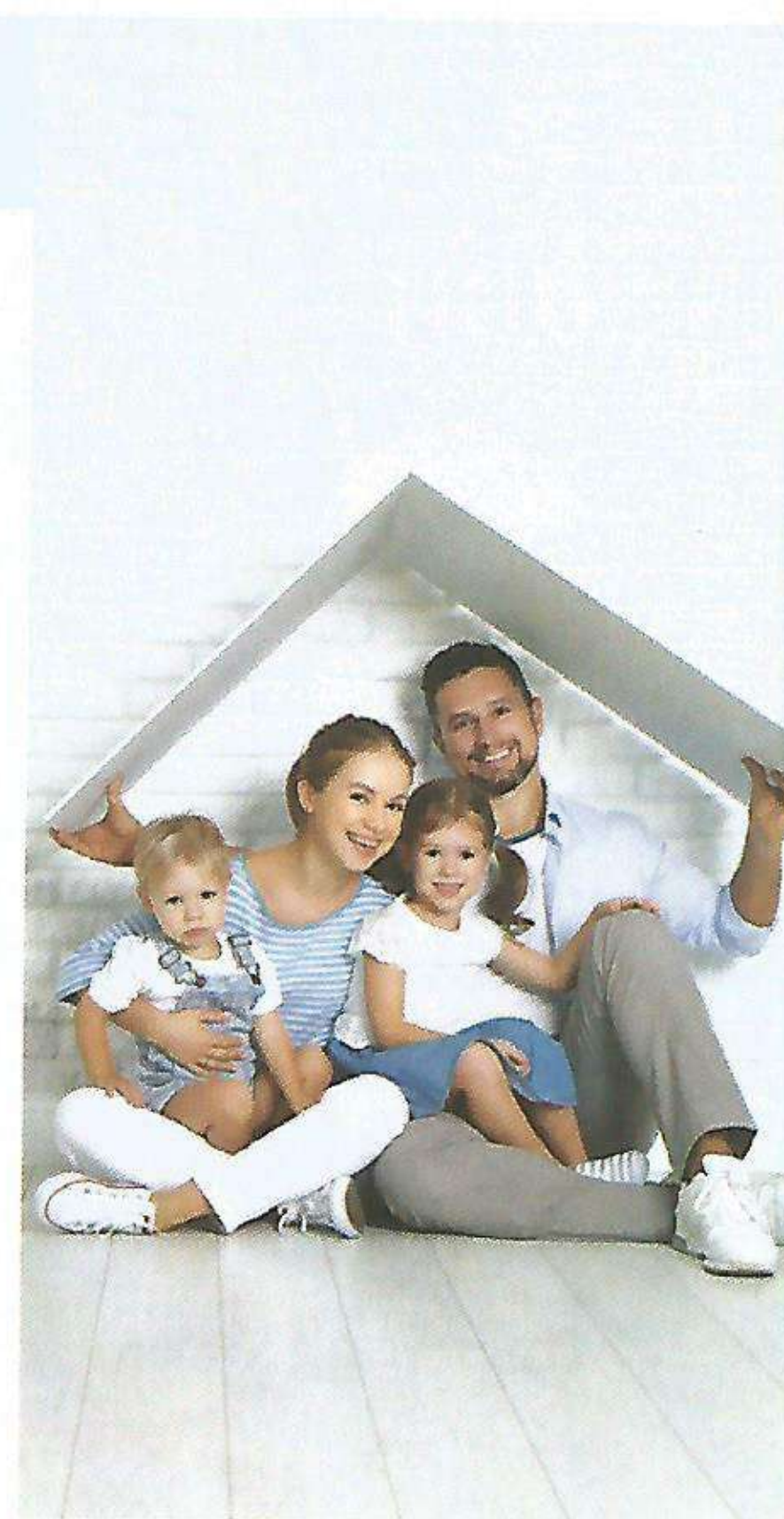
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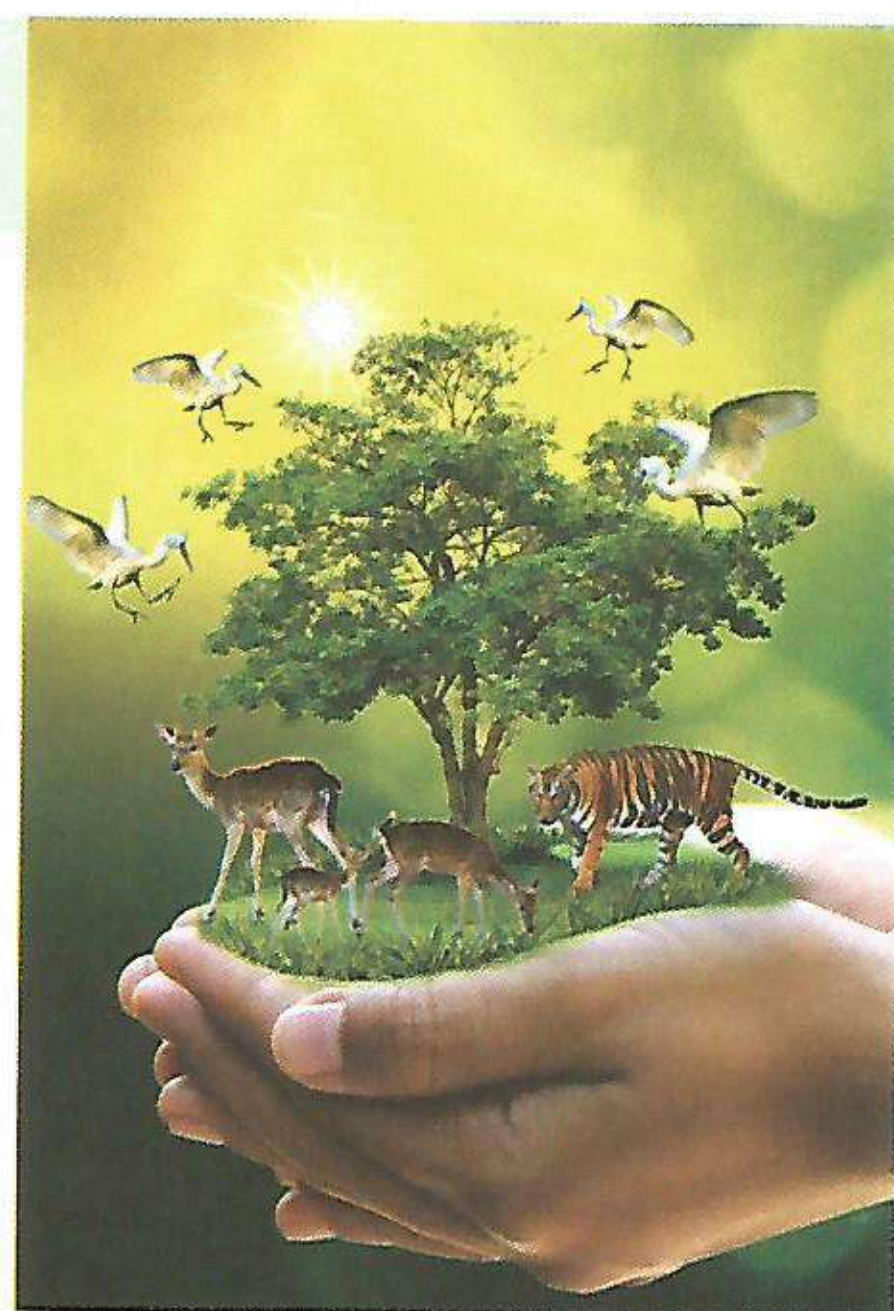
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UNIT

3

Inheritance of Traits

Chapter 1 Chromosomes and Genetic Information.

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Objectives of the unit

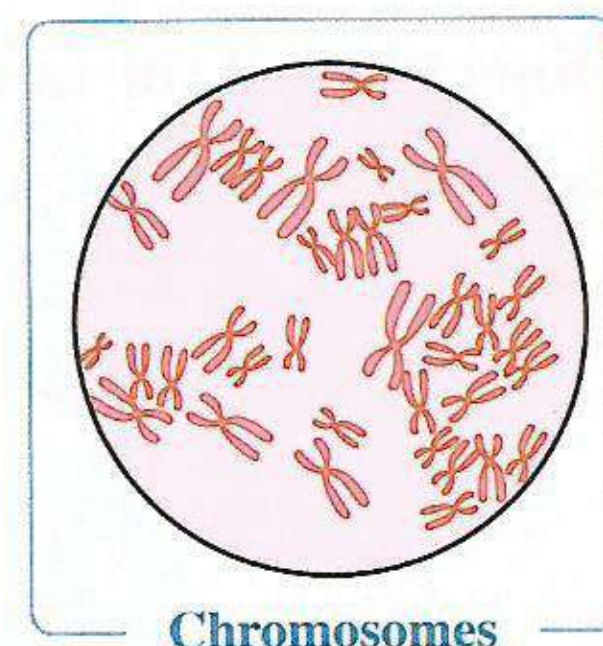
By the end of this unit, the student should be able to :

- Explain the chromosomal theory.
- Identify what is meant by the karyotype.
- Identify the number of chromosomes in some living organisms.
- Explain the mean of linkage.
- Identify what is meant by the crossing over phenomenon.
- Demonstrate the effect of genes interaction.
- Give examples for genes interaction.
- Explain the effect of the environmental conditions on the action of some genes.
- Explain how blood groups are inherited in humans.
- Explain how Rhesus factor is inherited.
- Explain the role of sex chromosomes in sex determination.
- Mention some sex-linked, sex-influenced and sex-limited traits.
- Distinguish between some abnormal cases of chromosomes in humans.
- Mention some methods used to predict the likelihood of genetic disorders occurring in offspring.
- Appreciate the importance of medical examinations before marriage to avoid the genetic diseases.

- **Chromosomes.**
- **Chromosomal Theory.**

- From a long time ago, man searches about how the genetic traits transmit across the successive generations and the causes of similarities and differences in genetic traits, till at the beginning of the 20th century, scientists discovered that :

- ▶ Genetic information which leads to the appearance of the genetic traits in all living organisms are carried on the chromosomes.
- ▶ Chromosomes are found inside the nucleus of each cell of all the living organisms' cells.



- **Genetically, there are two types of cells in all the living organisms' bodies :**

- ① Somatic (Body) cells.
- ② Sex cells (Gametes).

Karyotype



- We can photograph the chromosomes, when they are in the clearest form by using the microscope.
- Chromosomes are classified into homologous pairs (in somatic cells and gonads cells) and arranged descendingly according to their sizes, then they are numerated. This is called the **karyotype**.

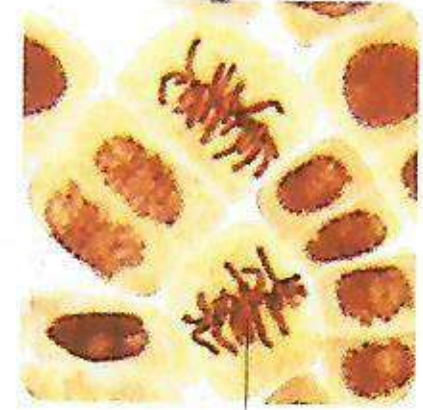
Karyotype

It is the arrangement of chromosomes descendingly, according to their sizes, then they are numerated.

- To facilitate the arranging and numerating of chromosomes, they can be stained with different colours.

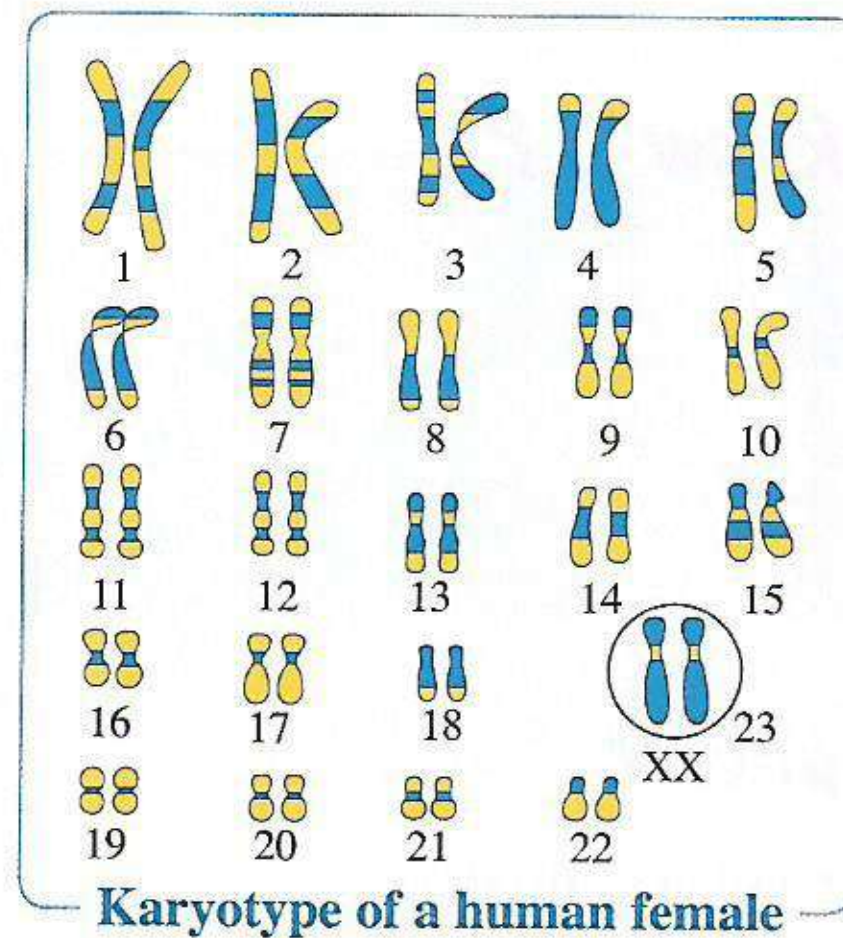
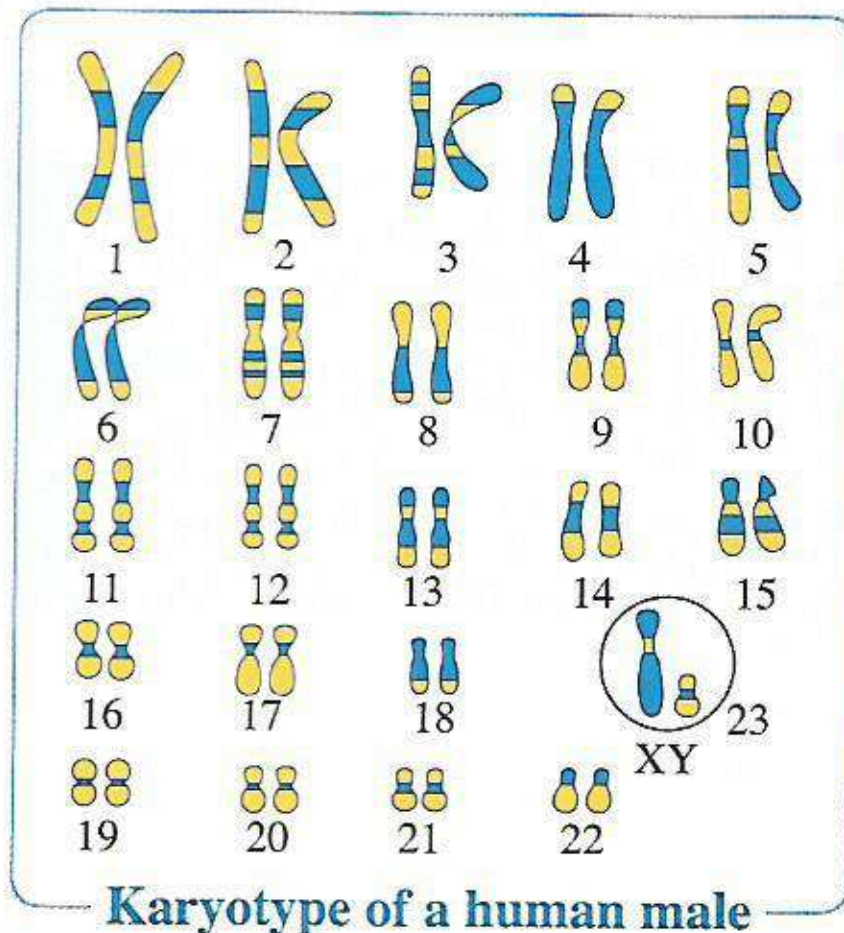
Note

- The chromosomes are in the clearest form under the microscope, during the metaphase of the cell division.



Metaphase

Example The karyotype of human male and female :



- From the previous two karyotypes of the human male and female, we conclude that :

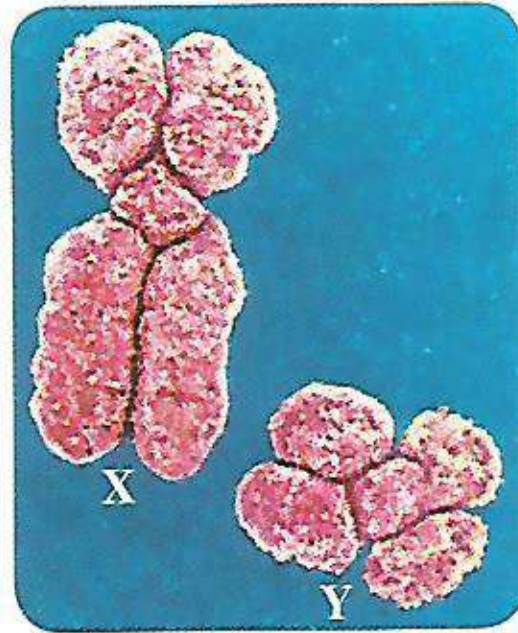
- 1 There are 46 chromosomes (23 pairs) in the human somatic cells (male or female).
- 2 These chromosomes are arranged descendingly in homologous pairs, according to their sizes from no. (1) : (23), where :
 - The pairs from no. (1) : (22) are called **autosomes** or **somatic chromosomes**.
 - The pair no. (23) represents the **sex chromosomes**, because it carries the genetic information for the sex determination (male or female).

3 The pair of sex chromosomes is characterized by the following :

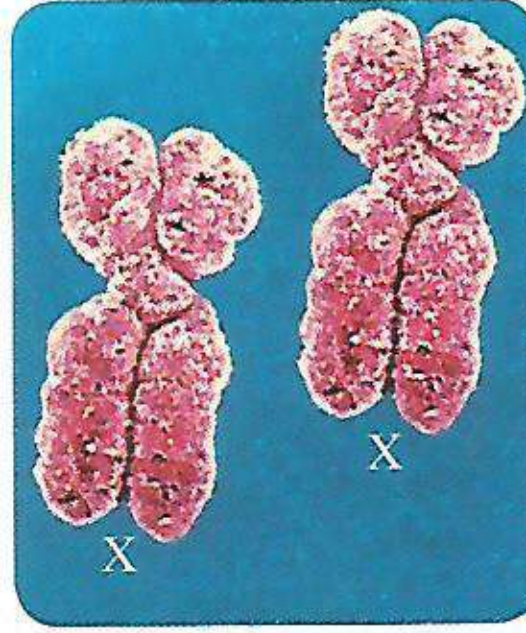
- It doesn't obey the chromosomes size arrangement, because it follows the pair of chromosomes no. (7) in size, but it is arranged at the end of the chromosomes and carries the number (23).
- It is heterozygous (asymmetric) in the male (XY), where one of them is long (X) and the other is short (Y).

- It is homozygous (symmetric) in the female (XX).

A pair of sex chromosomes (XY)
(In male)
"Asymmetric"



A pair of sex chromosomes (XX)
(In female)
"Symmetric"



So, the karyotype of human male differs from the karyotype of human female.

Do you know ...?

- The human cells and most of the animals cells like : horse, monkey and *Drosophila* contain two types of sex chromosomes which are (X) and (Y) which appear, as follows :
 - In female : the sex chromosomes are (XX).
 - In male : the sex chromosomes are (XY).

1 Test yourself

Answered

Choose the correct answer :

- (1) Which of the following describes the chromosome that distinguishes between the human male and female ?
 - (a) Its presence is restricted on sex cells only.
 - (b) It carries the number (8) in the karyotype.
 - (c) It has the smallest size in chromosomes.
 - (d) It follows the chromosome no. (7) in size.
- (2) In the light of your study for the human karyotype, what is the correct arrangement of the sex chromosome in the ovum according to the size?
 - (a) (1).
 - (b) (8).
 - (c) (22).
 - (d) (23).

Number of chromosomes

- The number of chromosomes in living organisms differs from one species to another, but it is constant in the individuals of the same species.
- The constancy of the chromosomal number in the individuals of the same species (male and female) indicates that the chromosomes carry the genetic information which determine the characters of the living organism.

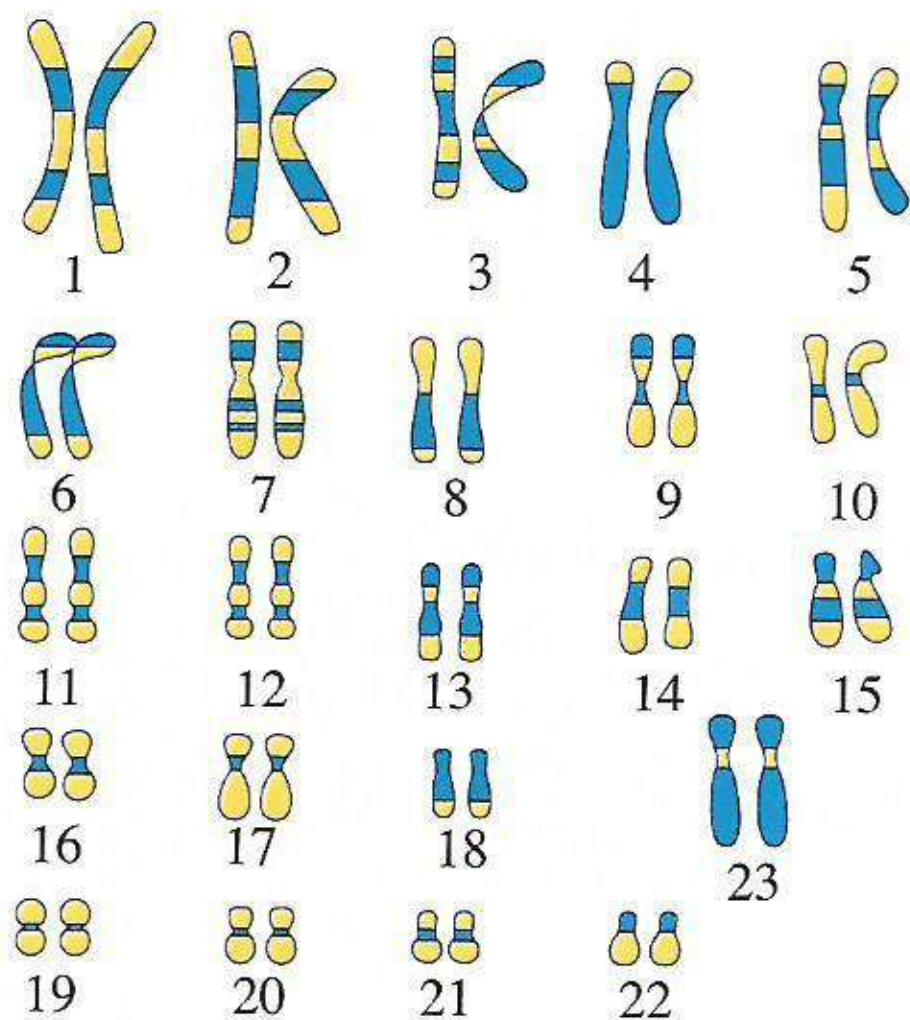
- The number of chromosomes in the living organisms somatic and sex cells (gametes) is different, as follows :

① Somatic cells

- ▶ They contain two sets of homologous chromosomes (one of them is inherited from the father and the other is inherited from the mother).
i.e. They are **diploid** cells ($2n$).
- ▶ They are produced from the **mitotic division** of the body cells.
- ▶ They include :
 - Skin cells.
 - Muscular cells.
 - Pancreatic cells.
 - White blood cells.

Examples

- ▶ The nucleus of the human somatic cell (as skin cell) contains 46 chromosomes (23 pairs).

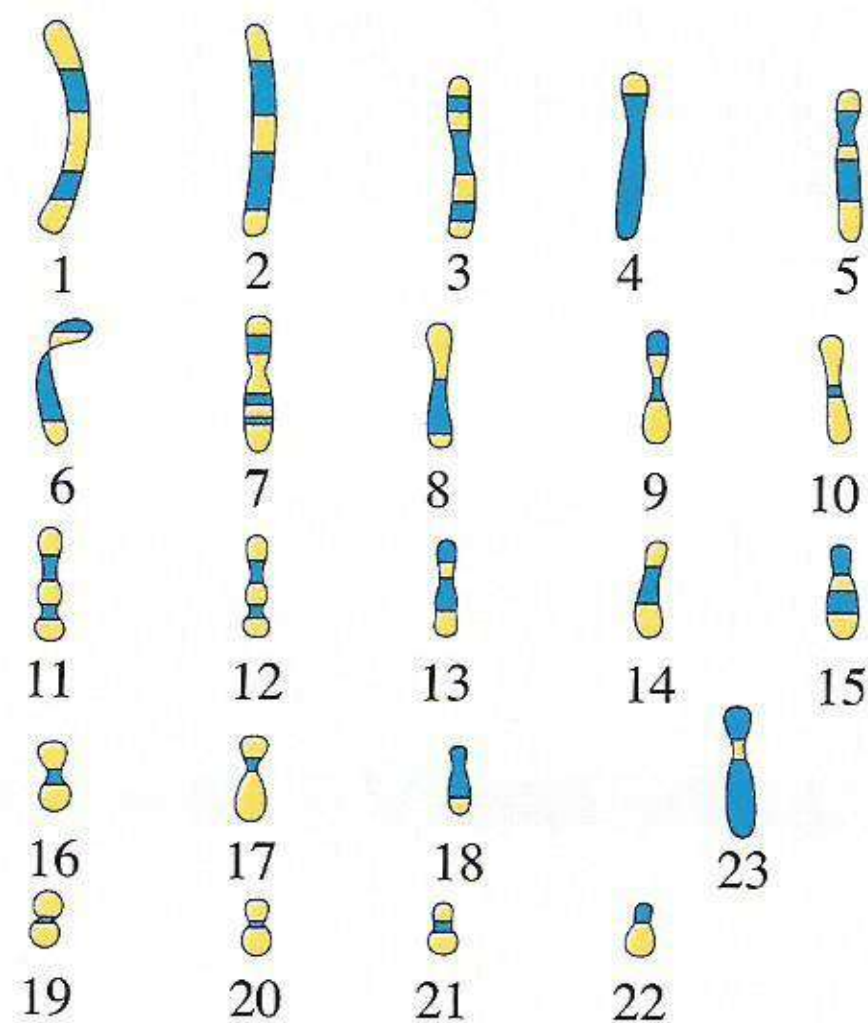


Karyotype of a somatic cell (in female)

② Sex cells (Gametes)

- ▶ They contain one set of chromosomes which is half the number of chromosomes that is found in the somatic cells in the form of single chromosomes.
i.e. They are **haploid** cells (n).
- ▶ They are produced from the **meiotic division** of gonads cells (male and female).
- ▶ They include :
 - Male gametes : pollen grains in plants and sperms in animals and human male.
 - Female gametes : ovules in plants and ova in animals and human female.

- ▶ The nucleus of the human male gamete (sperm) and female gamete (ovum) contains 23 chromosomes only.



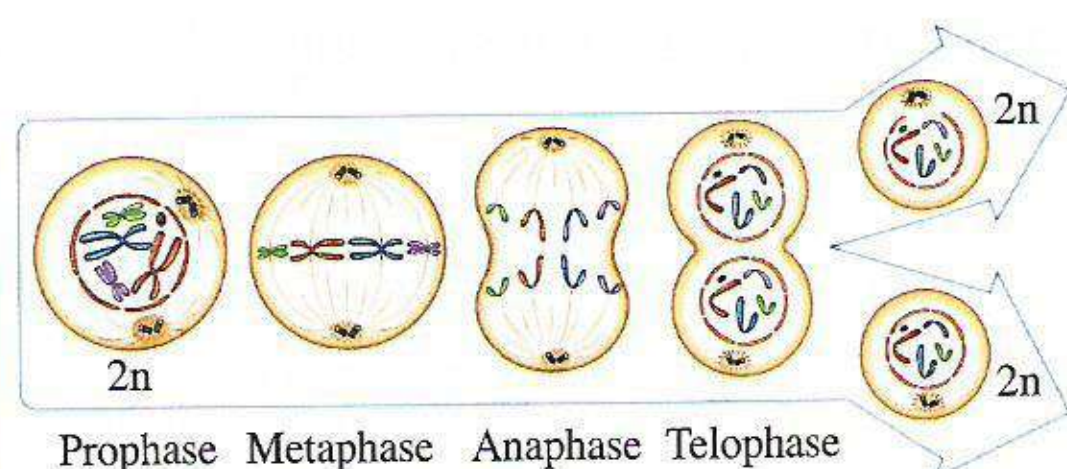
Karyotype of a sex cell

Do you know ...?

- There are two types of division, which are :

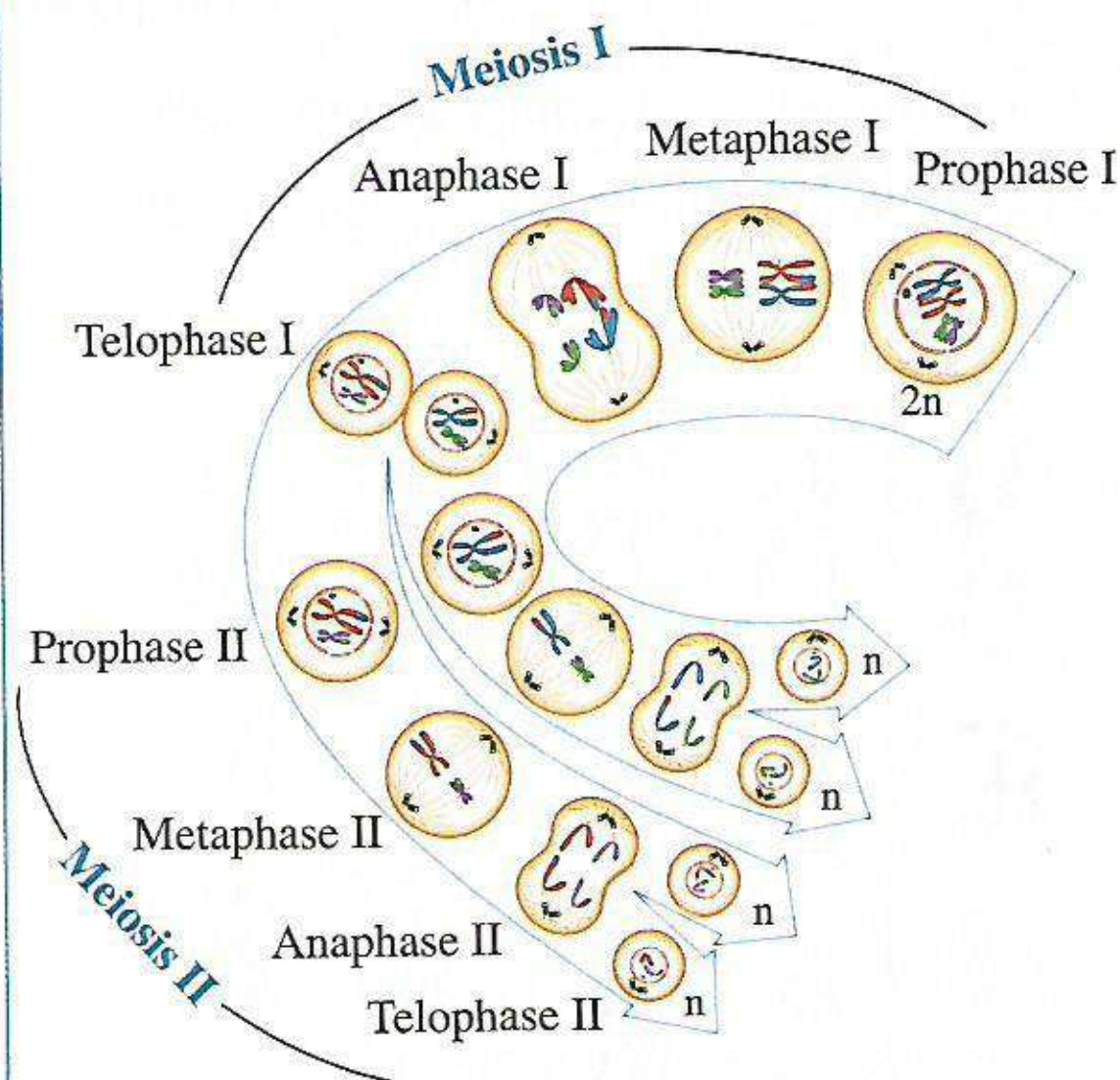
① Mitotic division

- Occurs in somatic cells.
- The number of chromosomes in the produced cells is identical to the number of chromosomes in the parent cell, this means that they are diploid ($2n$).
- The produced cells have the same genetic information of the parent cell. So, they have the same function.



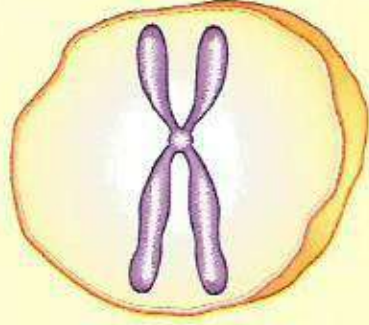
② Meiotic division

- Occurs in gonads cells (sex organs "testis – anther – ovary").
- The number of chromosomes in the produced cells (gametes) is half the number of chromosomes in the parent cell, this means that they are haploid (n).
- The produced cells (gametes) contain half the genetic information of the parent cell, due to reducing the number of chromosomes to half. Since the homologous pairs of chromosomes split into two equal groups of chromosomes distributed among the gametes.

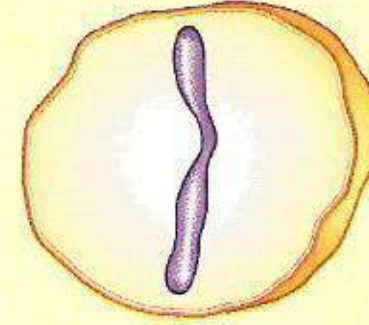


! Common mistake

- There is a common mistake that the chromosome is always dual chromatid in all the division phases. So, the correction of this mistake, as follows :



The chromosome is dual chromatid at the beginning of mitotic division, till the metaphase.



The chromosome has single chromatid in anaphase and telophase of mitotic division and it is called "**daughter chromosome**".

★ The following tables illustrate the number of chromosomes in somatic cells of some living organisms :

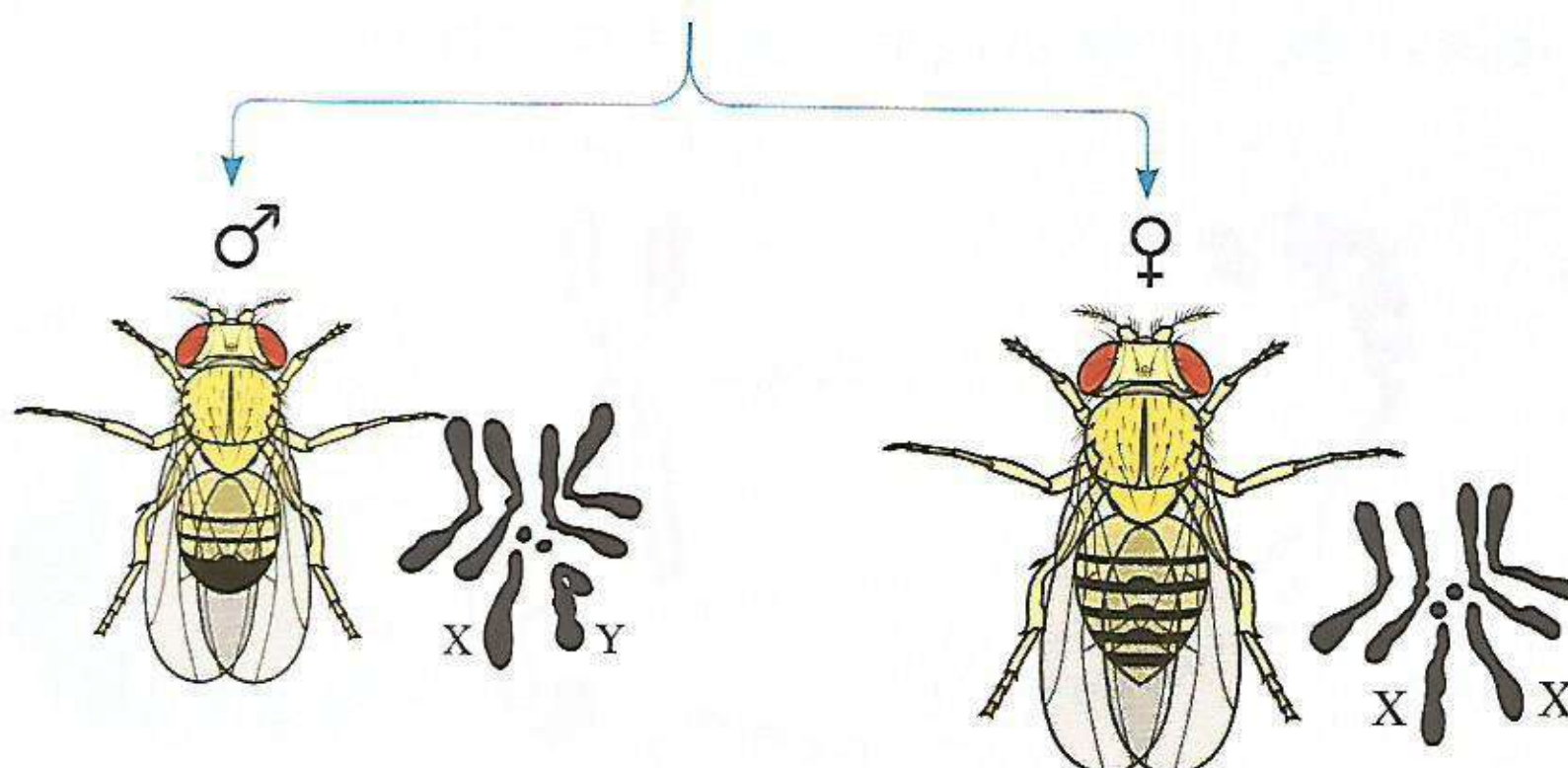
Enrichment information

The number of chromosomes in the living organisms cells doesn't express (indicate) its degree of evolution or its size.

Species	No. of chromosomes in somatic cell
Human	46 (23 pairs)
Hen	32 (16 pairs)
Cat	38 (19 pairs)
Fruit fly "Vinegar fly" (<i>Drosophila</i>)	8 (4 pairs)
Dog	78 (39 pairs)
Tobacco plant	48 (24 pairs)

Species	No. of chromosomes in somatic cell
Gorilla	48 (24 pairs)
Wheat plant	42 (21 pairs)
Onion plant	16 (8 pairs)
Sweet potato plant	48 (24 pairs)
Pea plant	14 (7 pairs)
Frog	26 (13 pairs)

Example The chromosomes in *Drosophila* insect :

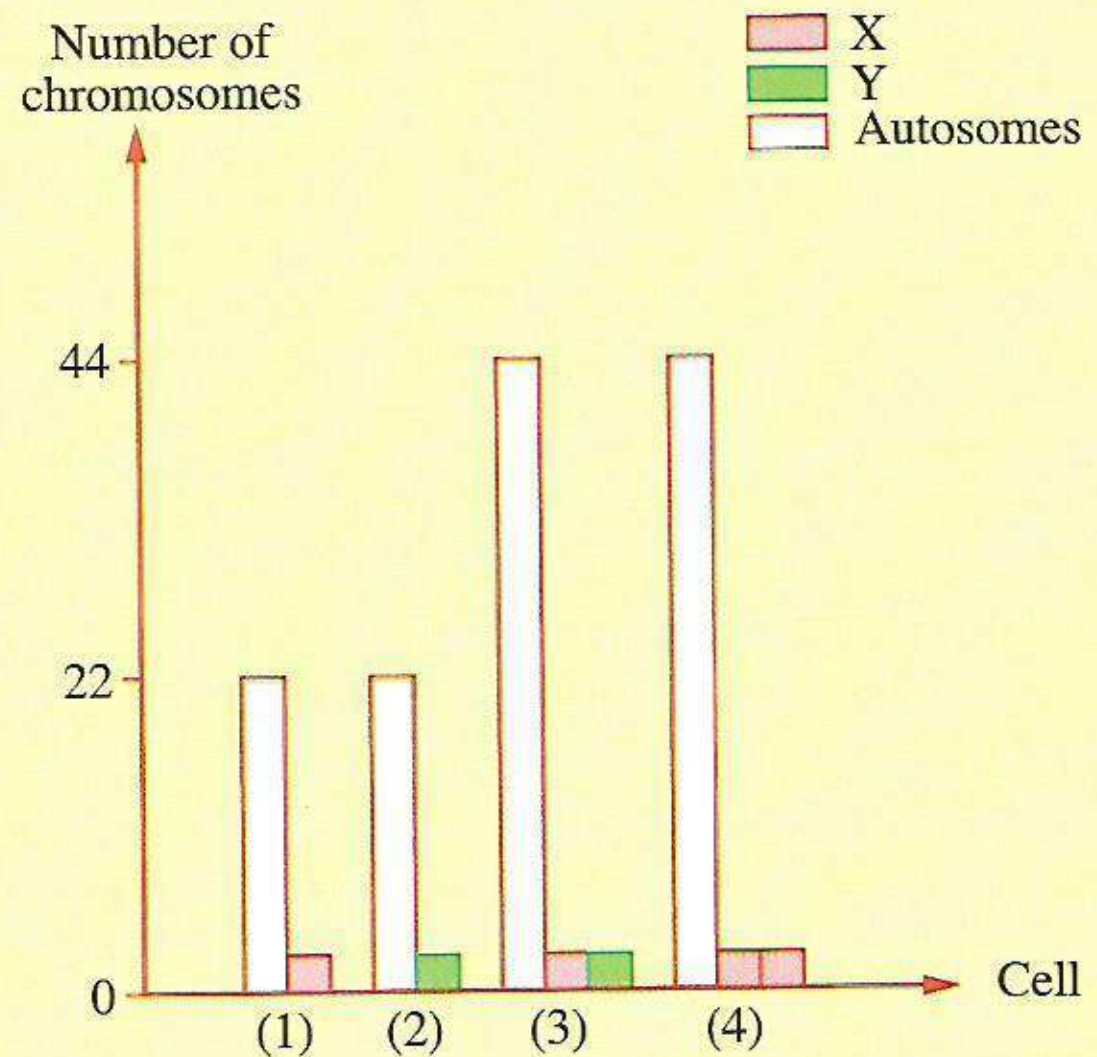


2 Test yourself

Answered

Examine the following graph, then choose the correct answer :

- (1) Which of the following represents the chromosomal structure of a cell from the liver of a normal human male ?
- (a) (1). (b) (2).
(c) (3). (d) (4).
- (2) Which of the following represents the chromosomal structure of a normal human female ovum ?
- (a) (1). (b) (2).
(c) (3). (d) (4).
- (3) Which of the following represents the chromosomal structure of a cell from the kidney of a normal human female ?
- (a) (1). (b) (2). (c) (3). (d) (4).



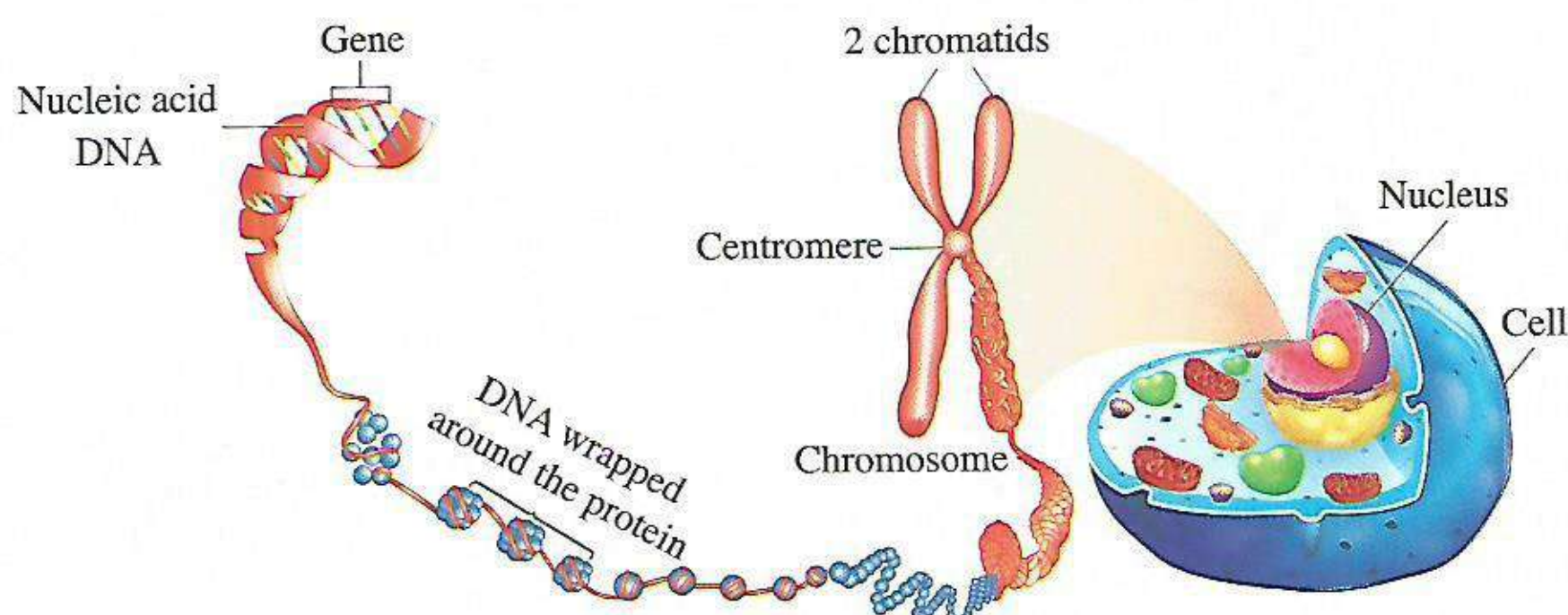
Chromosomes and genes

You have already known that :

- Chromosomes are present inside the nucleus of each cell of the living organisms cells and are made up of the nucleic acid DNA and protein.
- DNA consists of building units called nucleotides.
- DNA molecule carries genes which are responsible for the genetic traits of the living organism.

Gene

It is a sequence of nucleotides on the DNA molecule that represents a code for a certain protein that is responsible for the appearance of a certain trait.



Enrichment information

Scientists found that there are 60 - 80 thousand genes in the human somatic cells that are carried on 23 pairs of chromosomes. The complete set of genes in the cell is known as the "human genome".

Chromosomal theory

- In 1902, the two scientists Sutton and Boveri had reached the principles of the chromosomal theory, which are :



Sutton

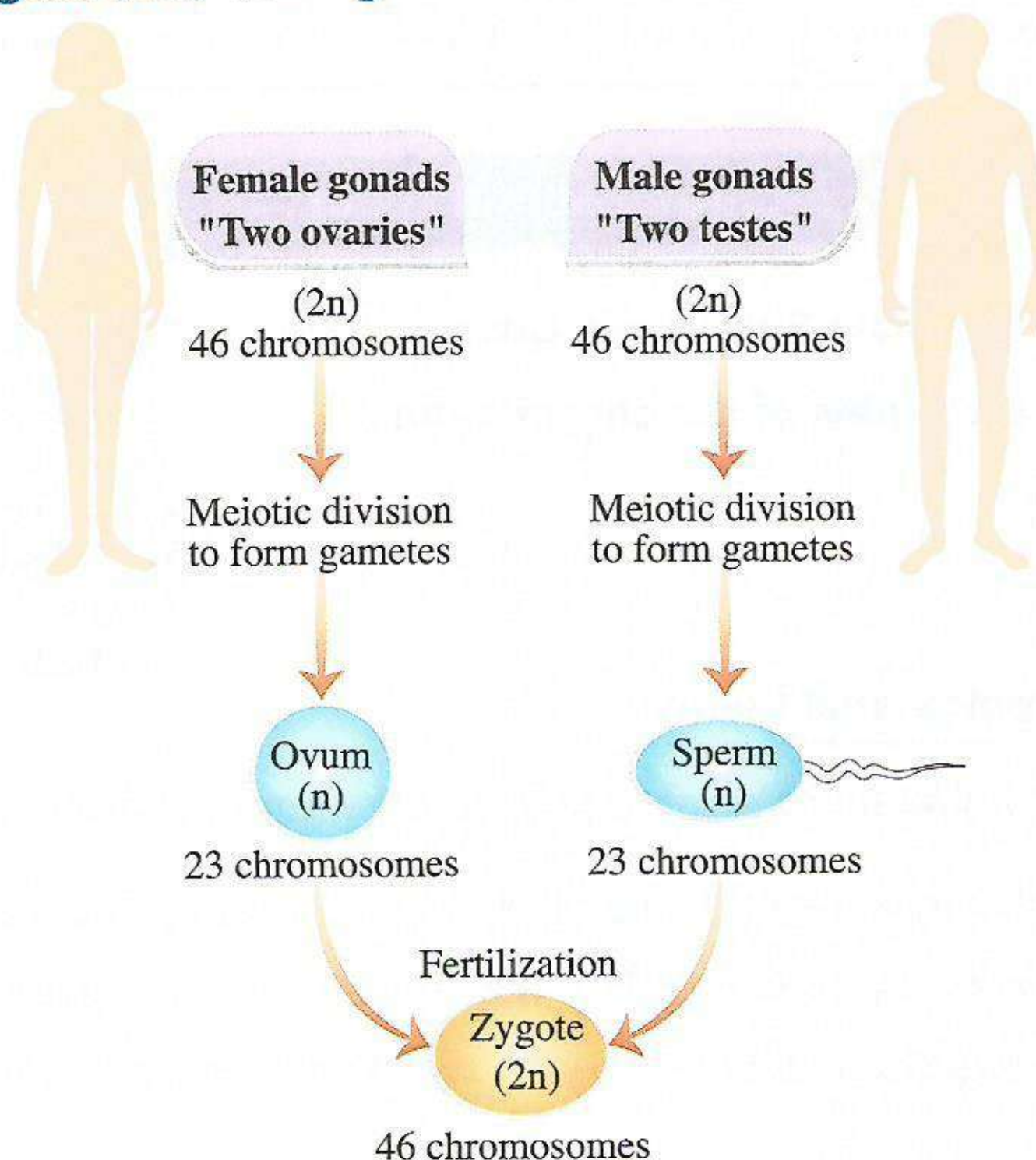


Boveri

Principles of the chromosomal theory

- 1 Chromosomes are found in the somatic cells in the form of homologous pairs ($2n$).
- 2 Sex cells (Gametes) contain half the number of chromosomes (n), due to the meiotic division of the gonads cells, where the homologous pairs of chromosomes are segregated into two equal sets of chromosomes and assorted among gametes.
- 3 Each pair of chromosomes behaves independently during its transmission in the gametes.
- 4 During fertilization "fusion of the male gamete (n) with the female gamete (n) to form the zygote ($2n$)", the diploid number of chromosomes returns back again ($2n$).
- 5 Genes are located on the chromosomes and the single chromosome may carry hundreds of genes.

★ The following diagram illustrates how the diploid number of chromosomes returns back again ($2n$) during fertilization :



3 Test yourself

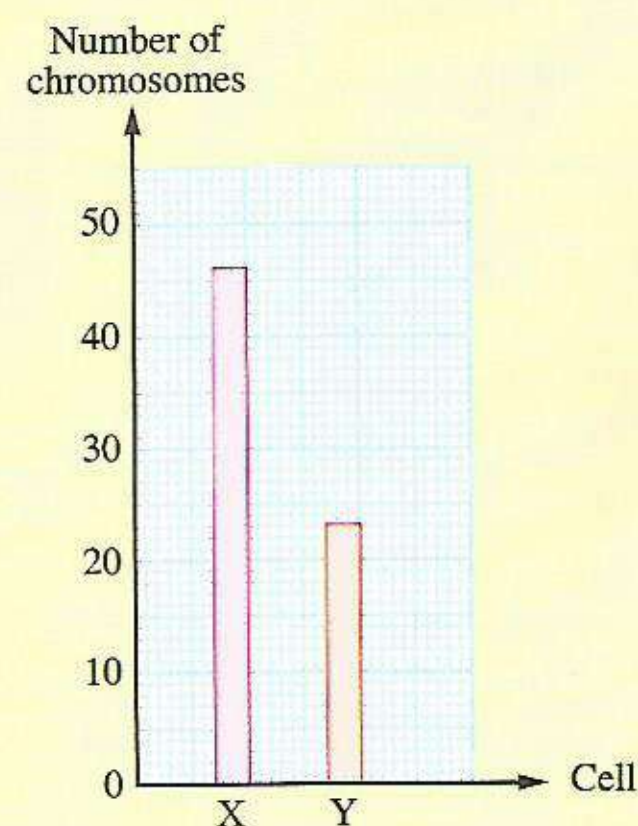
Answered

Choose the correct answer :

- (1) Which of the following statements is correct ?
- (a) The gene represents a code for several proteins in the cell.
 - (b) The protein is just the gene expression about itself.
 - (c) The protein represents a code for several genes in the cell.
 - (d) DNA molecule represents a code for one type of proteins.

- (2) The opposite graph shows two cells (X) and (Y) in human which are respectively.

	(X)	(Y)
(a)	Ovum	Sperm
(b)	Sperm	Brain cell
(c)	Skin cell	Sperm
(d)	Skin cell	Brain cell




- (3) The nucleus of a human female stomach cell contains

- (a) homozygous pair of sex chromosomes.
- (b) heterozygous pair of sex chromosomes.
- (c) somatic chromosomes only.
- (d) sex chromosomes only.

• Chromosomes. • Chromosomal Theory.



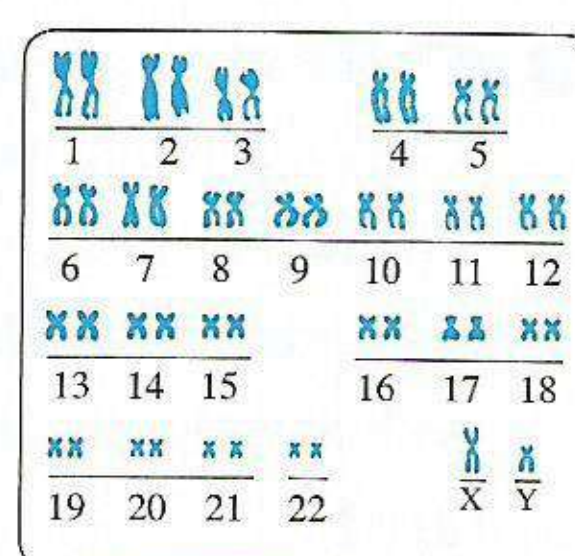
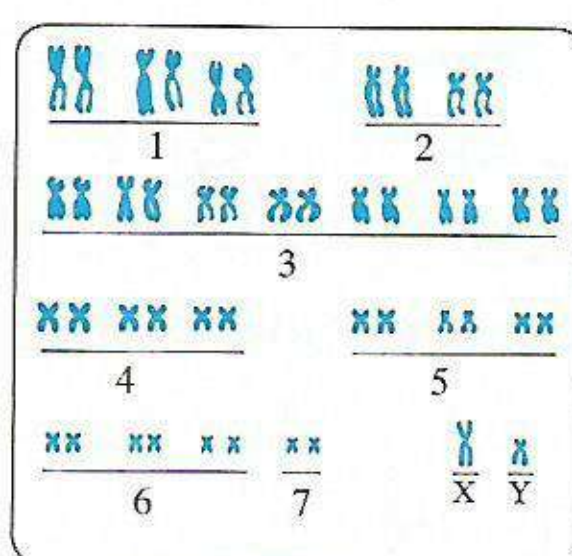
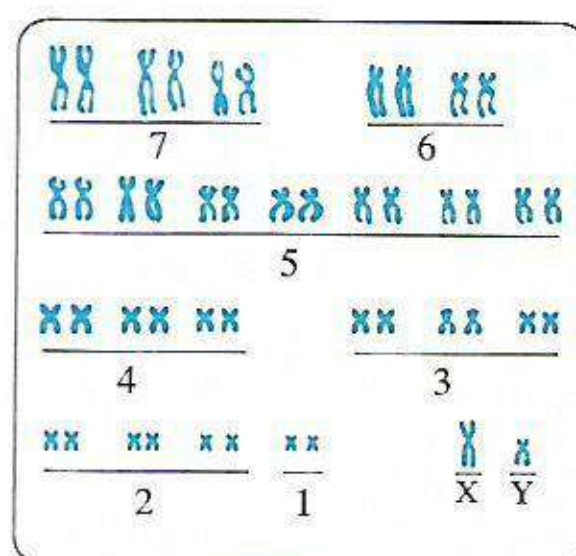
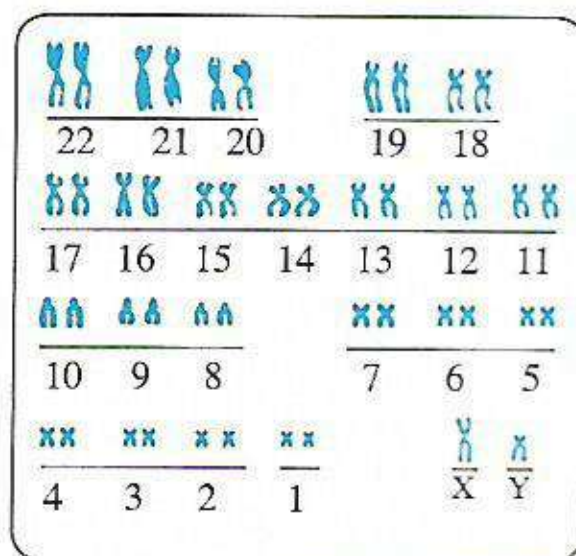
Interactive test

The questions signed by  measure the high levels of thinking.

First

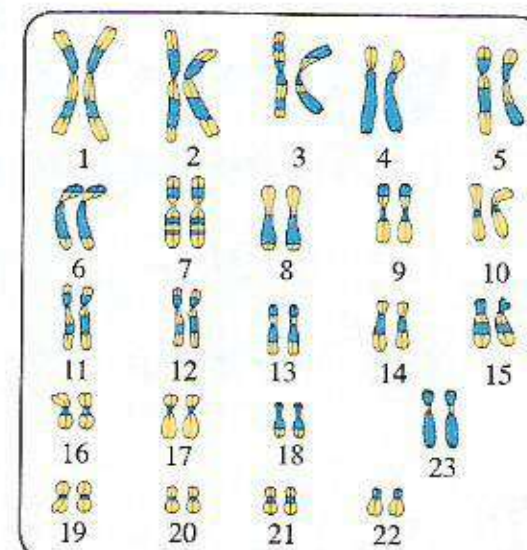
Multiple Choice Questions

1 What is the correct figure representing the human male karyotype ?




2 Which of the following can't be determined when studying the opposite karyotype ?

- (a) The sex of the living organism.
- (b) The number of autosomes.
- (c) The number of sex chromosomes.
- (d) The somatic traits of the living organism.



3 The karyotype of the human male differs from that of the female in

- (a) the number of sex chromosomes.
- (b) the number of somatic chromosomes.
- (c) the type of sex chromosomes.
- (d) the order of somatic chromosomes.

4  If the number of autosomes in an ovum of a living organism is (X), its body cells contain chromosomes.

- (a) X
- (b) 2X
- (c) X + 1
- (d) 2X + 2

5 If the number of chromosomes in a human skin cell is (23) pairs, the number of autosomes in the sperm is

- (a) 22
- (b) 23
- (c) 22 pairs.
- (d) 23 pairs.

6 In the karyotype of a human female, the pair no. (23) of chromosomes is larger in size than the pair no. of chromosomes.

- (a) (5)
- (b) (6)
- (c) (7)
- (d) (8)

7 All the following indicate that the chromosomes carry the genetic information in human, except that

- (a) their number in each somatic cell is 46
- (b) their number in each sex cell is 23
- (c) their number is constant after fertilization.
- (d) their number is identical in all the cell's types.

8 The two opposite figures (A) and (B) represent a blood sample and a sample of seminal fluid for a person respectively, which of the following expresses the total number of chromosomes in both samples ?

- (a) 92
- (b) 276
- (c) 414
- (d) 506

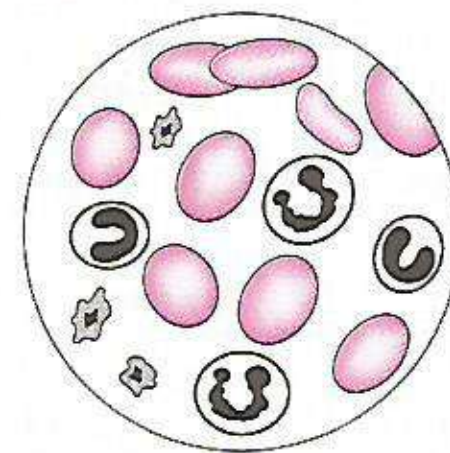


Figure (A)

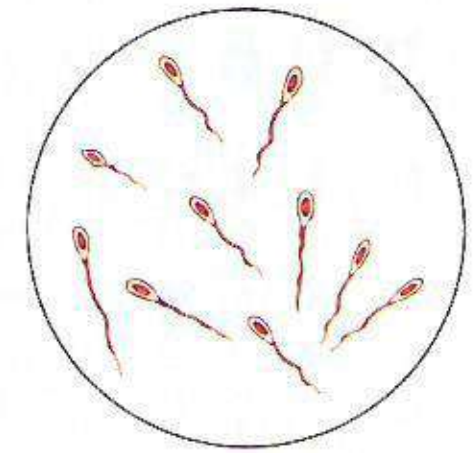


Figure (B)

9 Both the nucleus of somatic cell and the nucleus of gamete cell in human contain all the following respectively, except

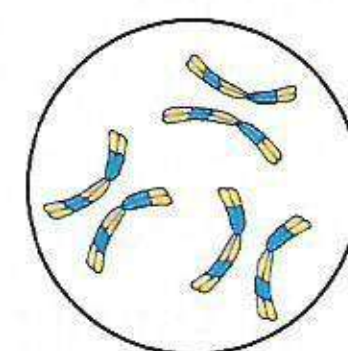
- (a) 46 DNA molecules and 23 DNA molecules.
- (b) 46 chromosomes and 23 chromosomes.
- (c) 2 sex chromosomes and 22 autosomes.
- (d) 46 autosomes and 22 autosomes.

10 The ratio between the number of sex chromosome (X) in each of a boy arm muscle cell and a girl arm muscle cell is respectively.

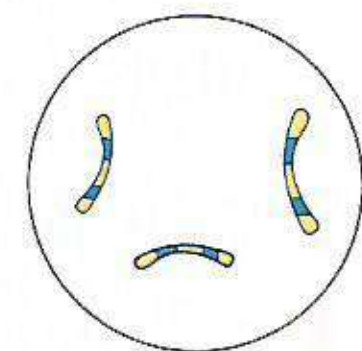
- (a) 1 : 2
- (b) 1 : 1
- (c) 2 : 1
- (d) 1 : 3

11 It is clear from the two cells (1) and (2) that they are respectively.

- (a) somatic cells for two different organisms
- (b) somatic cell and sex cell for the same organism
- (c) different somatic cells for the same organism
- (d) sex cells for two different organisms



Cell (1)



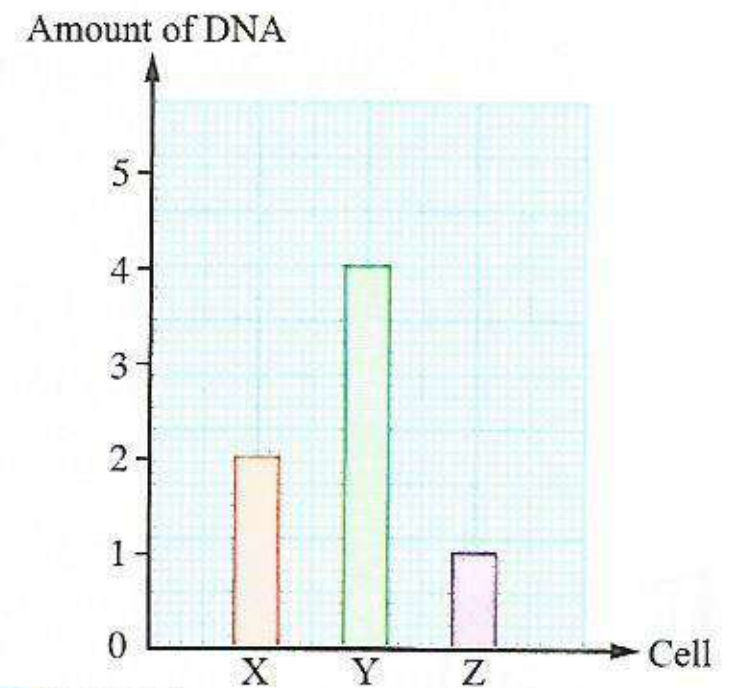
Cell (2)

12 If the sequence of nucleotides in DNA molecule which expresses a certain gene is changed, all the following will happen, except that

- (a) the type of the resulting protein will change.
- (b) the expressed character will change.
- (c) the code of the gene will change.
- (d) all the genetic characters will change.

- 13 The opposite graph represents the DNA content in three different cells for the same living organism, which of these cells can represent a cell in skin tissue (in case of no division) ?

(a) (X) only. (b) (Z) only.
(c) (X) and (Z). (d) (Y) and (Z).



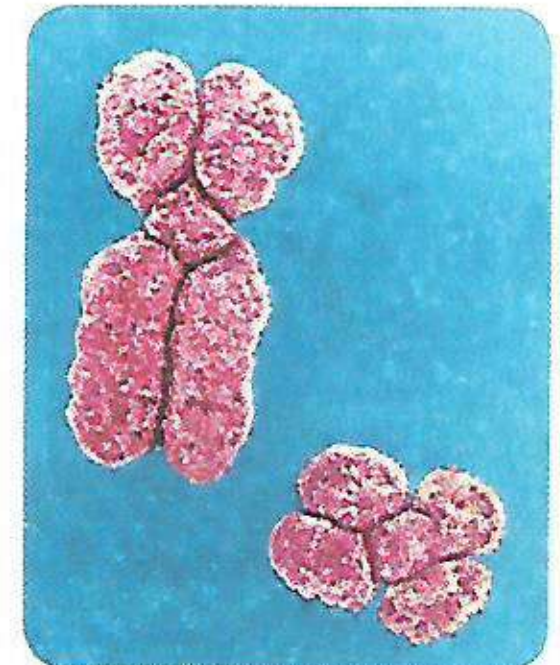
- 14 The opposite figure shows a pair of chromosomes in a stomach cell for a certain person, study it, then answer the following :

(1) The taller chromosome is more likely to be found in the somatic cells for this person with

(a) 25% (b) 50%
(c) 75% (d) 100%

(2) The shorter chromosome is present in

(a) all the male somatic cells.
(b) all the male gametes.
(c) all the somatic cells and gametes in males.
(d) all the somatic cells and gametes in females.



- 15 The sperms in human differ from each other in

(a) the number of somatic and sex chromosomes together.
(b) the number of sex chromosomes only.
(c) the type of sex chromosome.
(d) the size of somatic chromosomes.

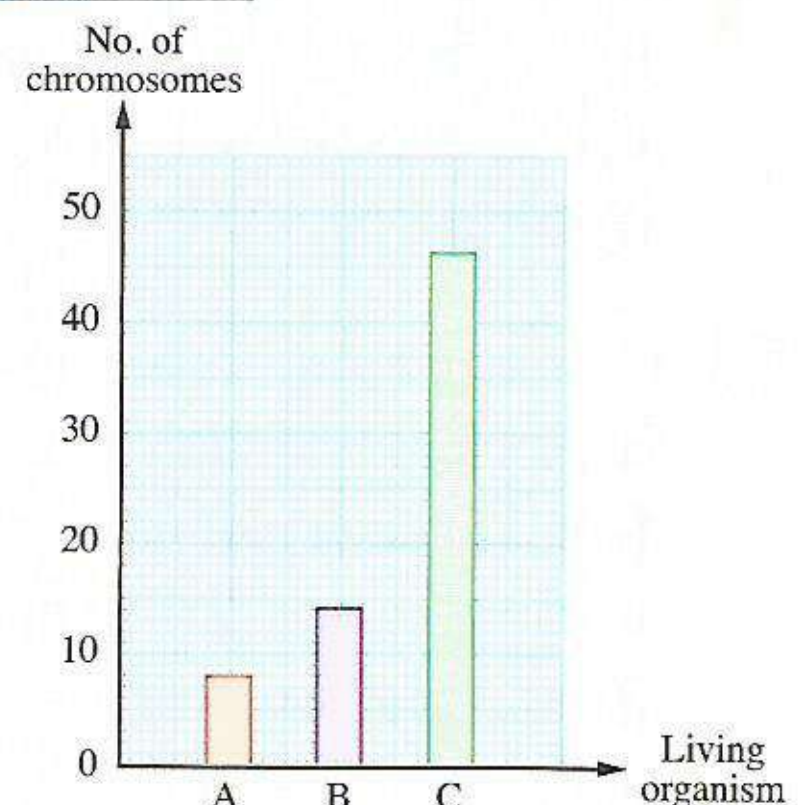
- 16 The sperm in human contains all the following, except

(a) the tall or short sex chromosome.
(b) half the number of chromosomes found in the somatic cell.
(c) 22 autosomes.
(d) the pair of sex chromosomes.

- 17 The opposite graph represents the number of chromosomes in the body cells for some living organisms, study it, then answer the following :

(1) The number of autosomes in a male sperm nucleus for organism (C) is

(a) one chromosome.
(b) two chromosomes.
(c) 23 chromosomes.
(d) 22 chromosomes.



(2) The number of chromosomes in the nucleus of a cell produced from meiotic division of an ovary cell in organism (A) is chromosome(s).

- (a) 8 (b) 4 (c) 1 (d) 2

(3) The number of chromosomes in the cell nucleus produced from mitotic division of a plant stem cell in organism (B) is chromosomes.

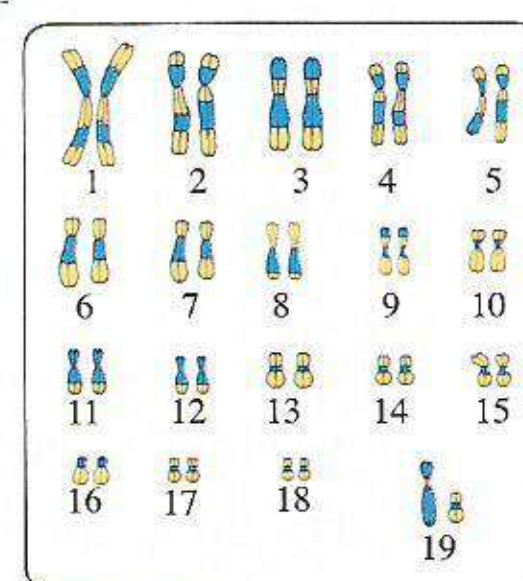
- (a) 7 (b) 14 (c) 21 (d) 28

18 If you know that the number of chromosomes in the nucleus of a plant stem cell is (42) chromosomes, the number of chromosomes in a pollen grain for that plant equals

- (a) 21 (b) 24 (c) 42 (d) 84

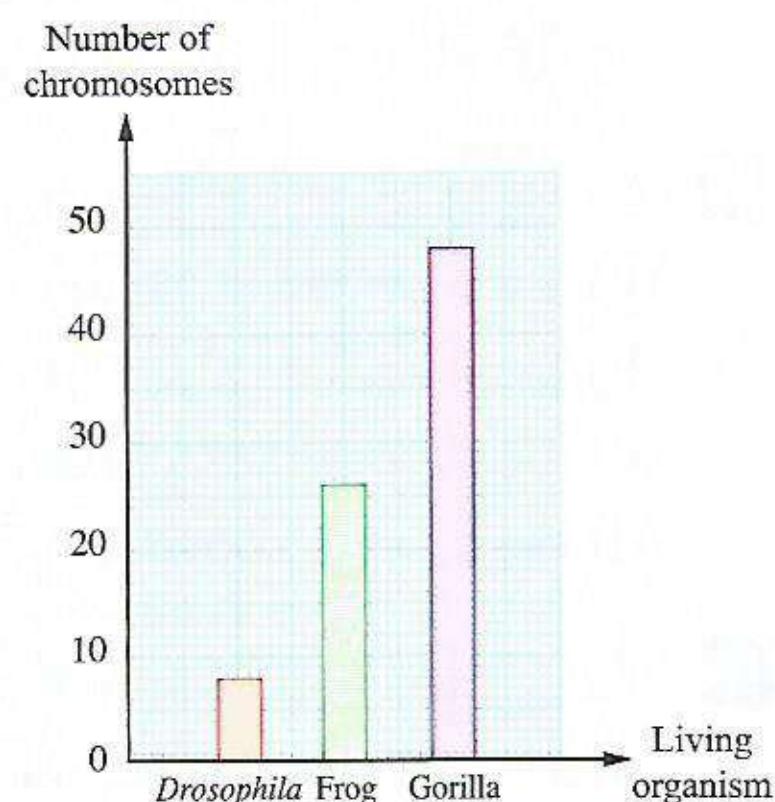
19 The opposite figure illustrates the karyotype of a cell of a living organism that resembles the human in sex determination, what does this karyotype represent ?

- (a) Somatic cell in a male.
(b) Somatic cell in a female.
(c) Gamete in a male.
(d) Gamete in a female.



20 From the opposite graph, it can be concluded that

- (a) there is an inversely relation between the number of chromosomes and the degree of evolution of the living organism.
(b) the number of genes carried on the chromosomes differs according to the type of the living organism.
(c) *Drosophila* contains genetic characters more than the frog.
(d) all the living organisms share in the genetic characters carried on the chromosomes.



21 The pair of sex chromosomes in the human female is characterized by all the following, except that

- (a) it follows the chromosomes pair no. (7) in size.
(b) it is arranged at the end of chromosomes.
(c) it carries the number (23).
(d) it is asymmetric.

22 The sex chromosomes are characterized by

[Choose two answers]

- (a) determining the sex in all the living organisms.
(b) being arranged descendingly in the karyotype.
(c) carrying no. (23) in all the living organisms.
(d) being in homologous pairs in all the living organisms.
(e) being always present at the end of the karyotype.

- 23 The diploid cells divide mitotically to give cells.
 (a) haploid (b) diploid (c) tetraploid (d) (a) and (b)
- 24 The pair of chromosomes that represents the smallest size in the human karyotype is the pair no.
 (a) (1). (b) (7). (c) (22). (d) (23).
- 25 The pair of chromosomes that is directly larger than the chromosomes pair no. (8) in size in the human female karyotype is the pair no.
 (a) (7). (b) (9).
 (c) (23). (d) (a) and (c) together.
- 26 The following figures show two karyotypes for a living organism that resembles the human in sex determination, study them, then answer :

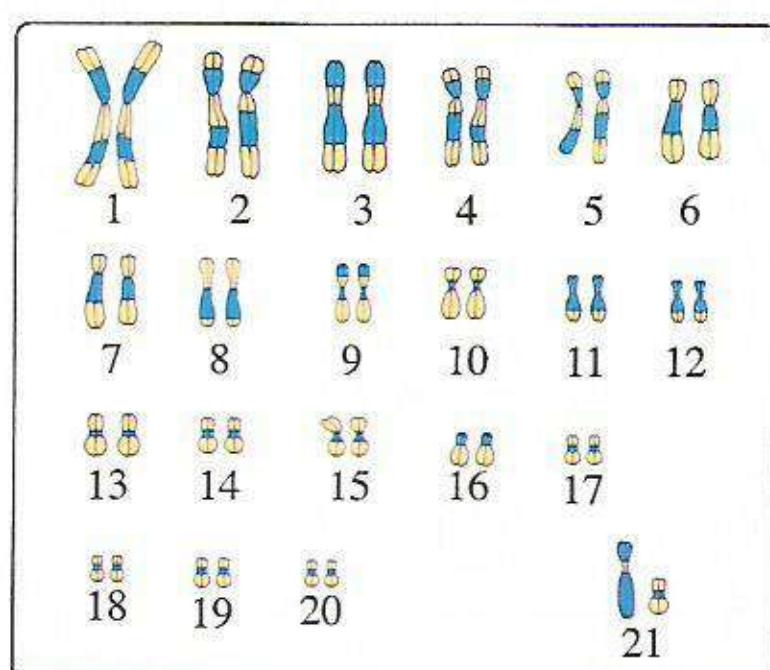


Figure no. (1)

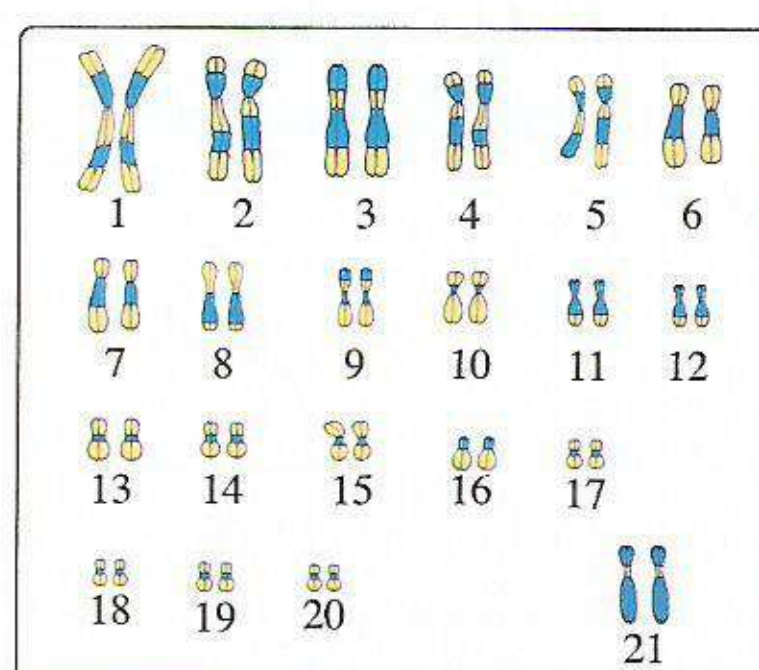


Figure no. (2)

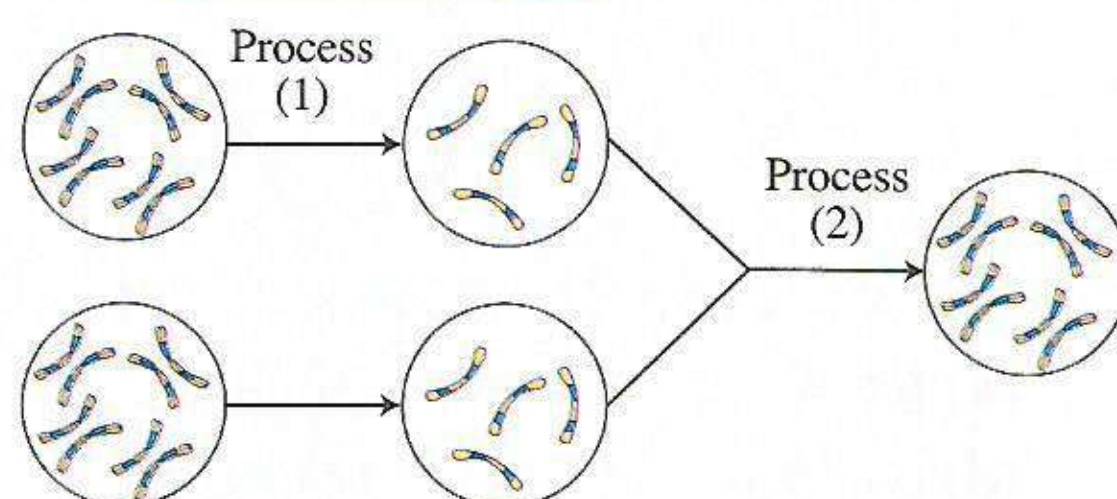
The two statements that are applied to the previous two figures are

[Choose two answers]

- (a) its chromosomal structure is (20 + XY).
 (b) it produces two types of gametes.
 (c) all chromosomes are found in homologous pairs.
 (d) the number of chromosomes is 21
 (e) its chromosomal structure is (20 + X).

- 27 From the opposite figure, processes (1) and (2) represent respectively.

- (a) meiotic division and fertilization
 (b) meiotic division and mitotic division
 (c) mitotic division and meiotic division
 (d) mitotic division and fertilization



28 If a cell passed through these stages : $(2n) \rightarrow (n) \rightarrow (2n) \rightarrow (2n)$, may be happened to it.

- (a) mitosis, meiosis then fertilization
- (b) meiosis, fertilization then mitosis
- (c) fertilization, meiosis then mitosis
- (d) mitosis, fertilization then meiosis

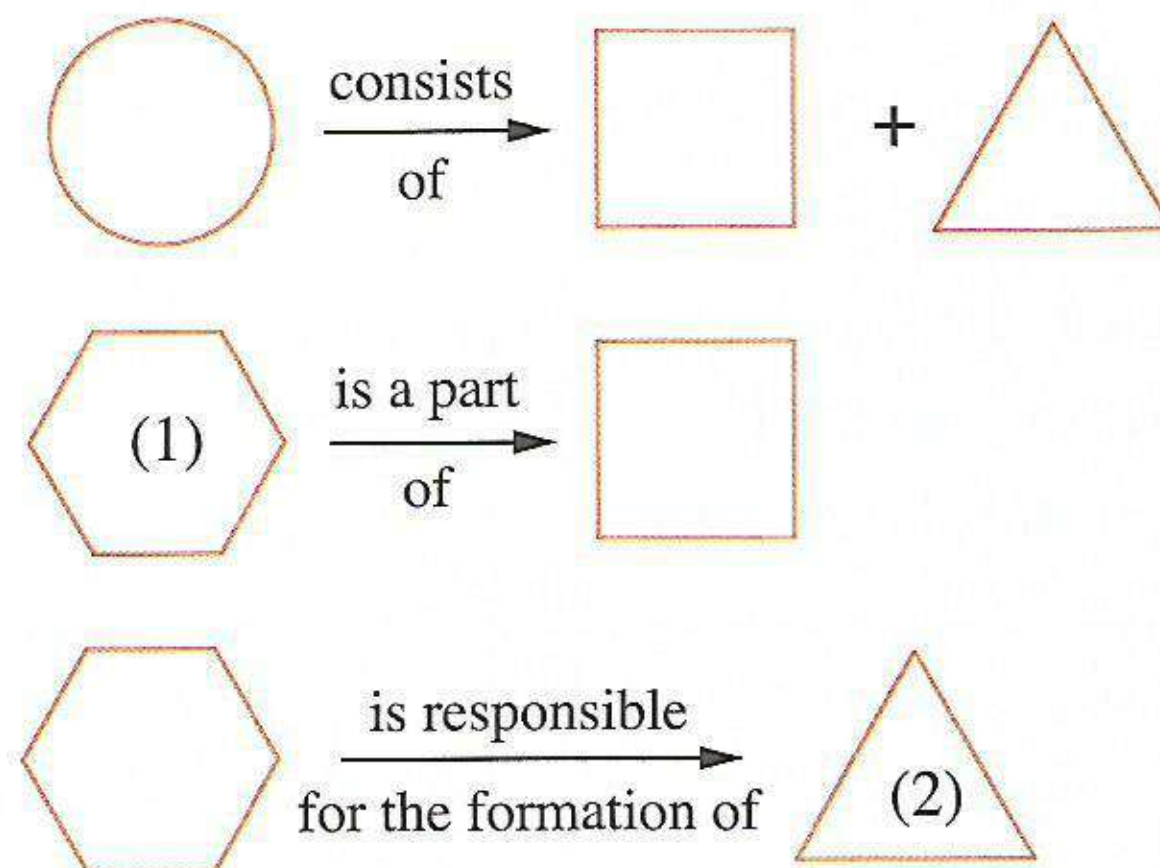
29 The even number of chromosomes is resulted when all the following happen, except that

- (a) a cell $(2n)$ is divided mitotically.
- (b) the zygote is formed.
- (c) the fertilization process is occurred.
- (d) a cell $(2n)$ is divided meiotically.

30 If the gene is symbolized by a triangle and the chromosome by a circle. Which of the following shapes represents the relation between the gene and the chromosome ?



31 The following figures represent some cell contents that are responsible for the appearance of genetic traits in the living organism, where the chromosome is represented by a circle and DNA is represented by a square :



The shapes no. (1) and no. (2) represent

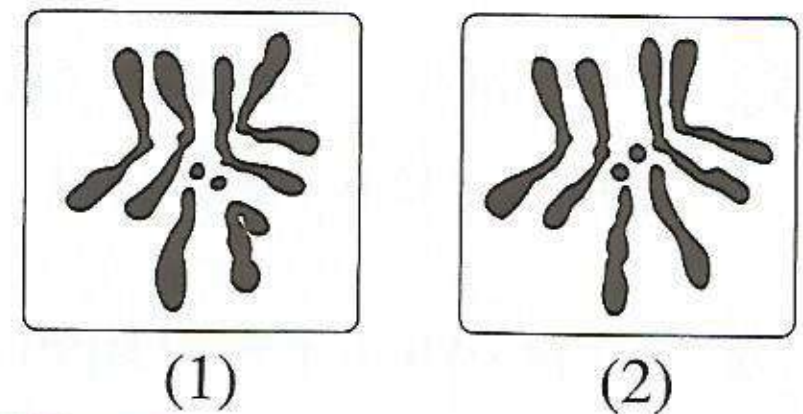
[Choose two answers]

- (a) RNA
- (b) gene.
- (c) nucleotide.
- (d) protein.
- (e) sugar.

- 32 Which of the following is applied to the pollen grains ? [Choose two answers]
- (a) They represent the male gametes in the plant.
 - (b) They are produced by meiotic division of petal cells in the plant.
 - (c) They contain the same number of chromosomes that are present in the ovule of the plant.
 - (d) In which the chromosomes are present in homologous pairs.
 - (e) They contain all the genetic information of the plant.

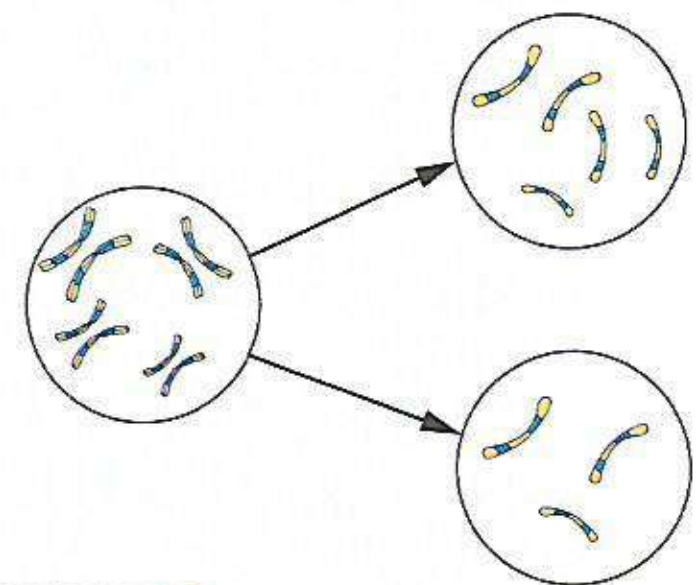
Second Miscellaneous Questions

- 1 The two opposite figures show two karyotypes (1) and (2) in *Drosophila* insect. What are the similarities and the differences between (1) and (2) ?



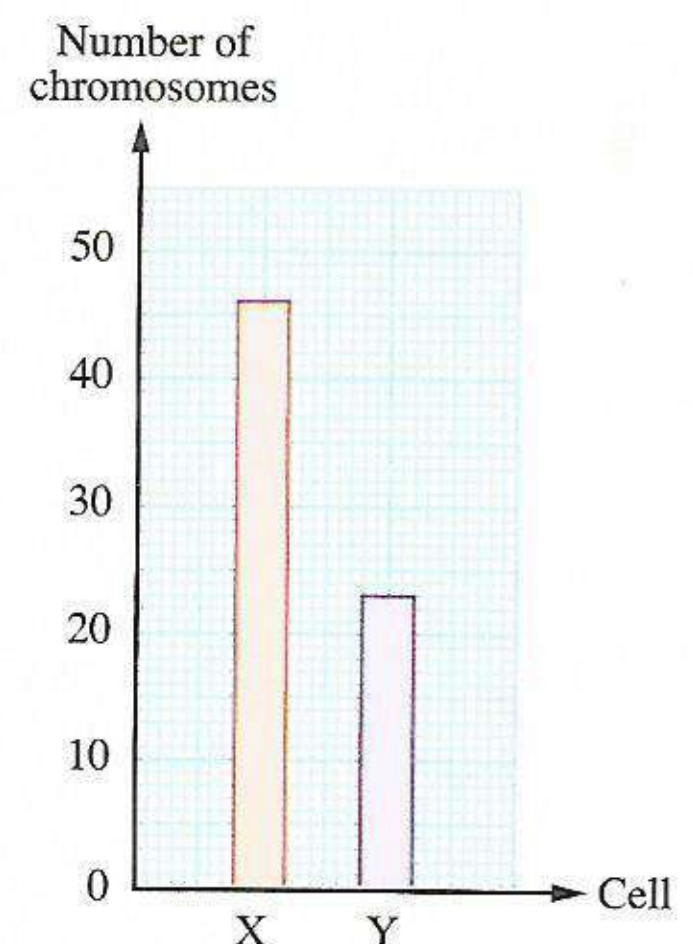
- 2 "We always get two identical karyotypes when the meiotic division takes place in the human gonads' cells". How far this statement is correct ? With explanation.

- 3 The opposite figure is incompatible with one of the principles of the chromosomal theory. Determine this principle, then show the mistake in this figure, and correct it.



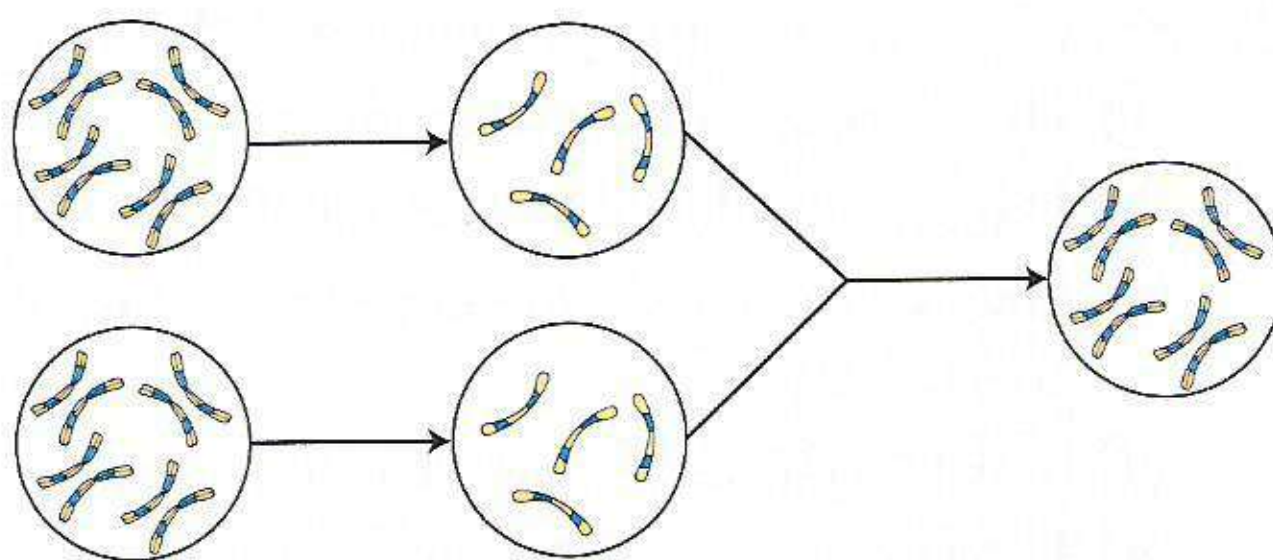
- 4 "The sex chromosome (Y) is necessary for the human life". How far this statement is correct ? With explanation.

- 5 The opposite graph shows the number of chromosomes in two different cells of an adult human male, study it, then answer :



- (a) What is the name of cell (Y) ?
And what is the number of autosomes found in it ?
Explain your answer.
- (b) Determine the chromosomal structure for cell (X).

- 6 The opposite figure expresses some principles of the chromosomal theory that are stated by Sutton and Boveri. Illustrate these principles.



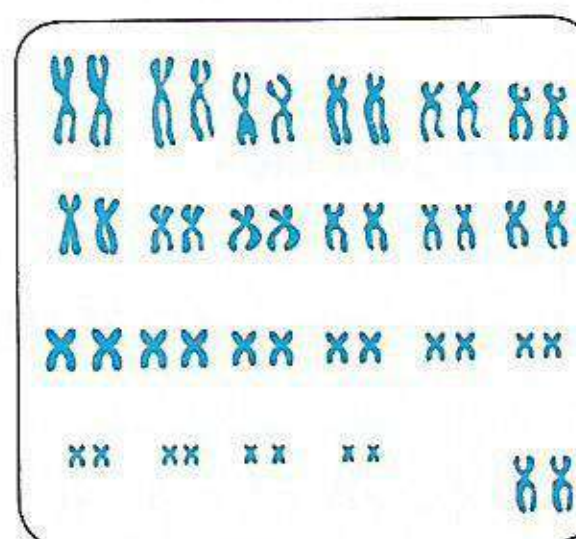
- 7 Give reason for : the somatic cell is symbolized by $(2n)$, whereas the gamete is symbolized by (n) .
- 8 "The gametes in living organisms are often formed by mitotic division". How far this statement is correct ? With explanation.

- 9 In the two opposite figures :

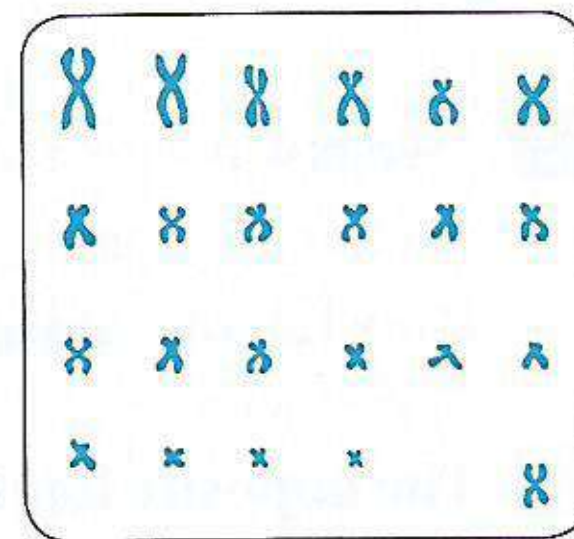
(a) Which one of these karyotypes represents a somatic cell ? And which one represents a sex cell ? And why ?

(b) Does the karyotype no. (1) represent a cell of a male or a female ? And why ?

(c) How many autosomes and sex chromosomes are present in both of karyotypes no. (1) and (2) ?



Karyotype (1)



Karyotype (2)

Mendel's Laws According to the Chromosomal Theory

Interpretation of Mendel's laws according to the chromosomal theory

Gregor Mendel

- In 1860, he arrived after his experiments on the green pea plant to the following :

- ① Each inherited trait is controlled by one pair of genetic factors (which are known later by genes) that may be dominant or recessive.
- ② Each pair of contrasting traits (dominant and recessive) is called **allelomorphic characters** (alternative characters).



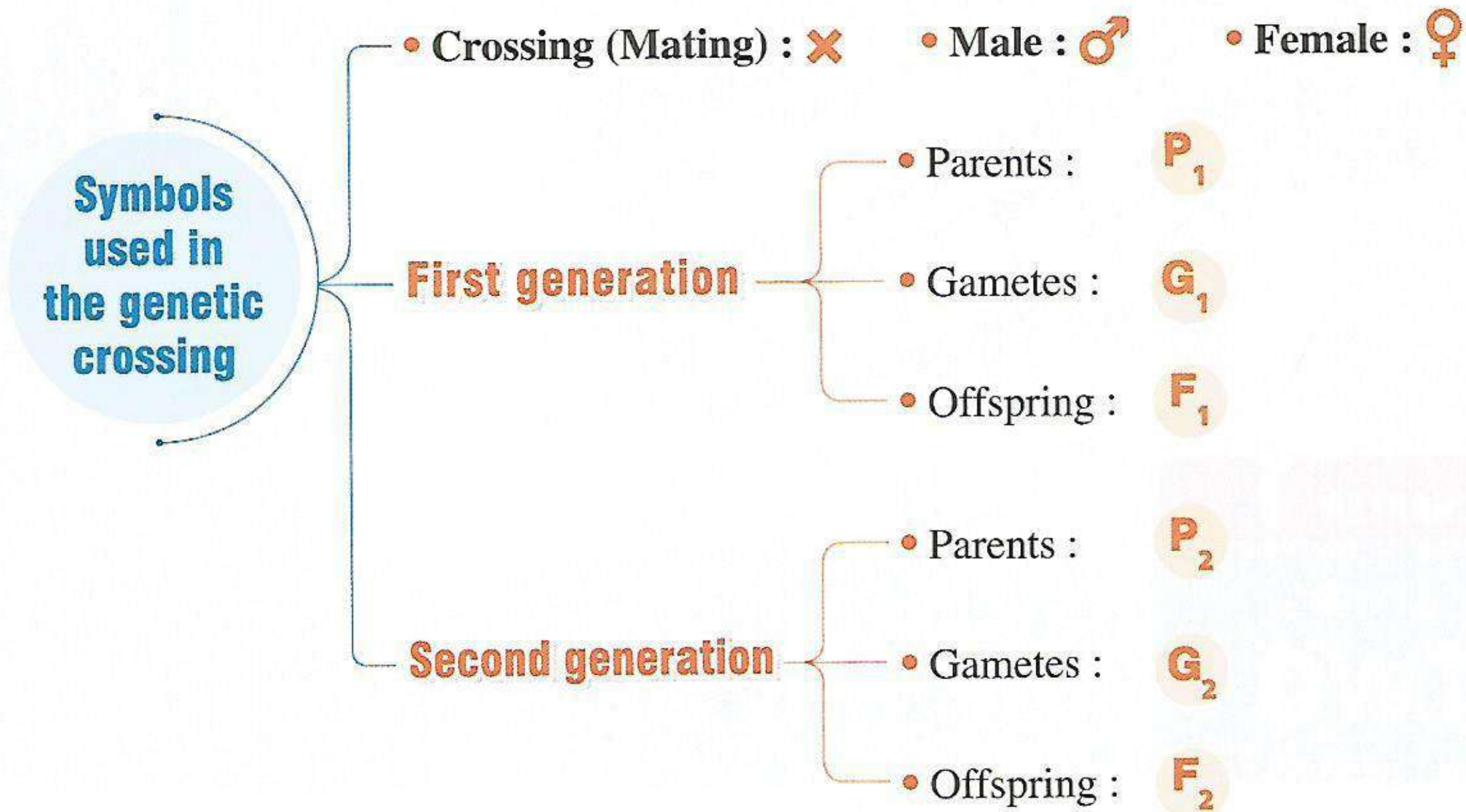
Mendel

Mendel's first law : **law of segregation of genetic factors** (explains the inheritance of a pair of **allelomorphic characters**)

- When crossing two homozygous (pure) individuals that differ in one pair of **allelomorphic characters** (i.e. one of them carries the dominant trait in a pure form and the other carries the recessive trait of the same character) :
 - The dominant character appears with 100% in the first generation **F₁**.
 - Both the dominant and recessive characters appear in the members of the second generation **F₂** with a ratio (3 : 1) respectively.

These characters are called **mendelian characters** which are complete dominant traits. So, this genetic pattern is called "**complete dominance**".

- In meiosis, the genes carried on the chromosomes pairs are segregated into gametes, and the chromosomes return back again in pairs during fertilization.



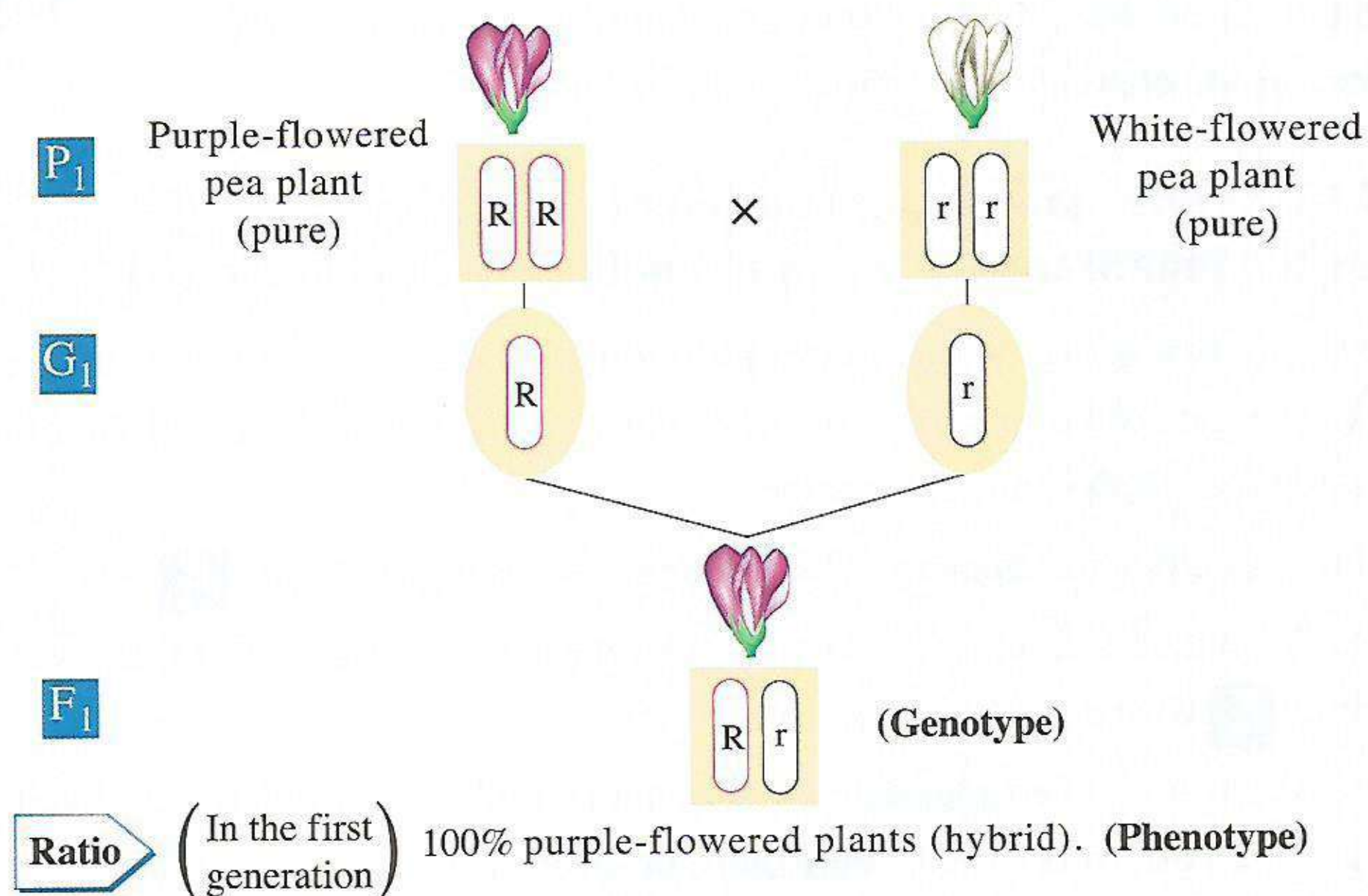
Example Inheritance of one pair of characters (inheritance of flowers colour character in pea plant) :

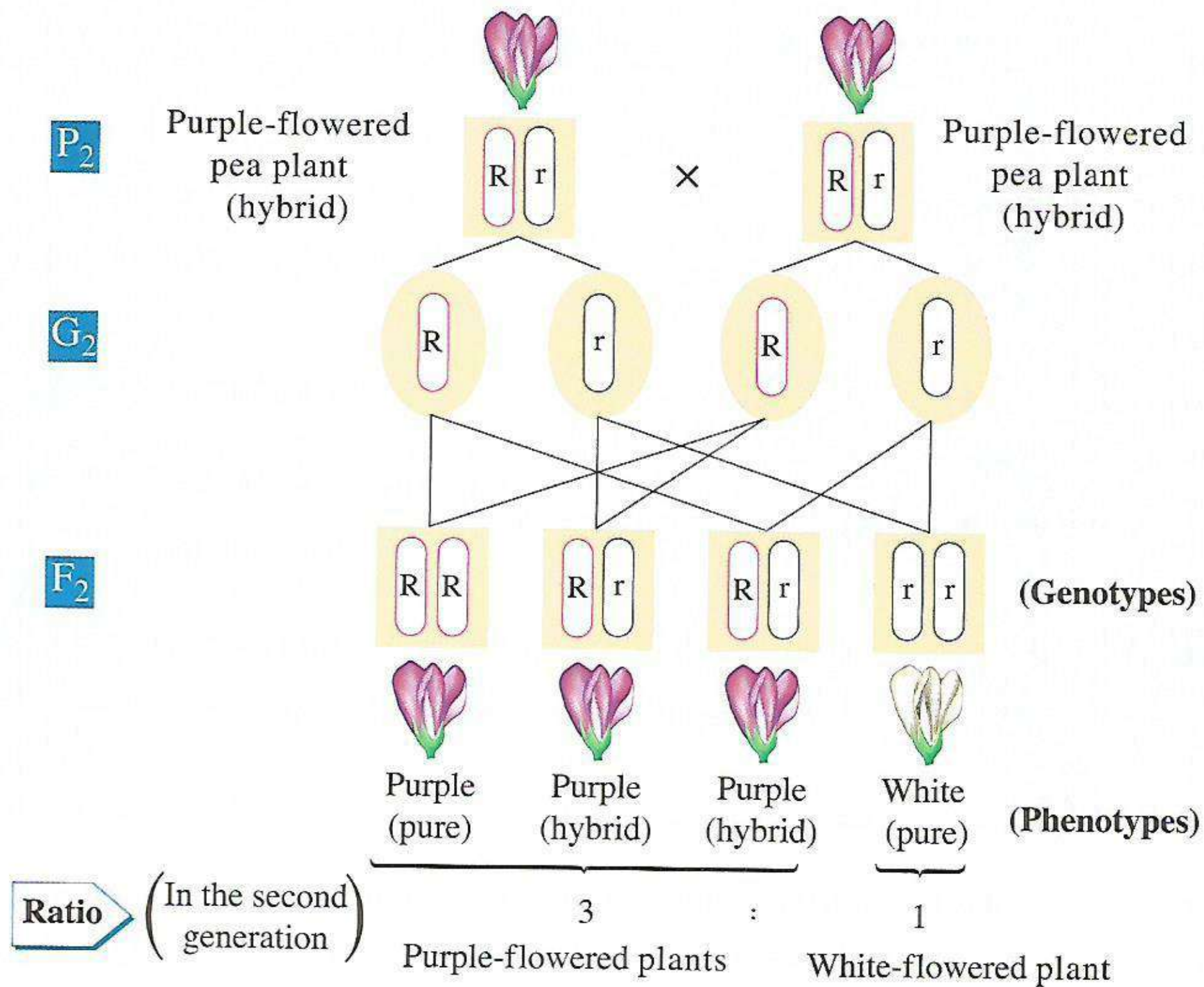
If you know that : the purple colour gene of flowers (R) dominates over the white colour gene (r).

It is possible to express the crossing of a pure purple-flowered pea plant with a white-flowered pea plant genetically for two generations, as follows :

Note

Any pair of allelomorphic characters is known as **Genotype**.
Example : (Rr) is genotype for purple flower colour.





• From the previous example, we can conclude the following :

- ① The genetic character is represented by a pair of genes which may be :
 - **Symmetric (pure), such as :**
 - Purple colour (RR) which is called pure dominant.
 - White colour (rr) which is called recessive and it is always pure.
 - **Asymmetric (hybrid), such as :** purple colour (Rr) which is called hybrid dominant.
- ② The segregation of flowers colour (purple and white) genes which are carried on the chromosomes pairs in gametes **G₁** & **G₂**, then their fusion once more during fertilization to form the members in **F₁** & **F₂**.
- ③ Members of the first generation carry (bear) the dominant character (purple colour) with 100%, while members of the second generation carry (bear) the dominant and recessive characters (purple colour- white colour) with a ratio (3 : 1) respectively.
- ④ The appearance of purple colour in the members of the first generation with 100%, because the gene of purple colour (R) dominates over the gene of white colour (r).
- ⑤ The appearance of white colour among the members of the second generation, due to the presence of two genes of the recessive character together (rr).

Parents			Resulted generation
1	Dominant (pure)	× Dominant (pure)	100% pure dominant
2	Recessive	× Recessive	100% recessive (always pure)
3	Dominant (pure)	× Recessive	100% dominant (hybrid)
4	Dominant (hybrid)	× Dominant (hybrid)	3 dominant (25% pure dominant and 50% hybrid dominant) : 1 recessive
5	Dominant (hybrid)	× Recessive	50% dominant (hybrid) : 50% recessive

1 Test yourself

Answered

- 1 When crossing a black-coloured male animal with a white-coloured female animal, 12 black-coloured individuals were produced, when crossing a white-coloured male with one of the resulted females, 6 black-coloured individuals and 6 white-coloured individuals were produced. **What are the genotypes of the parents and offspring ?**
-
-

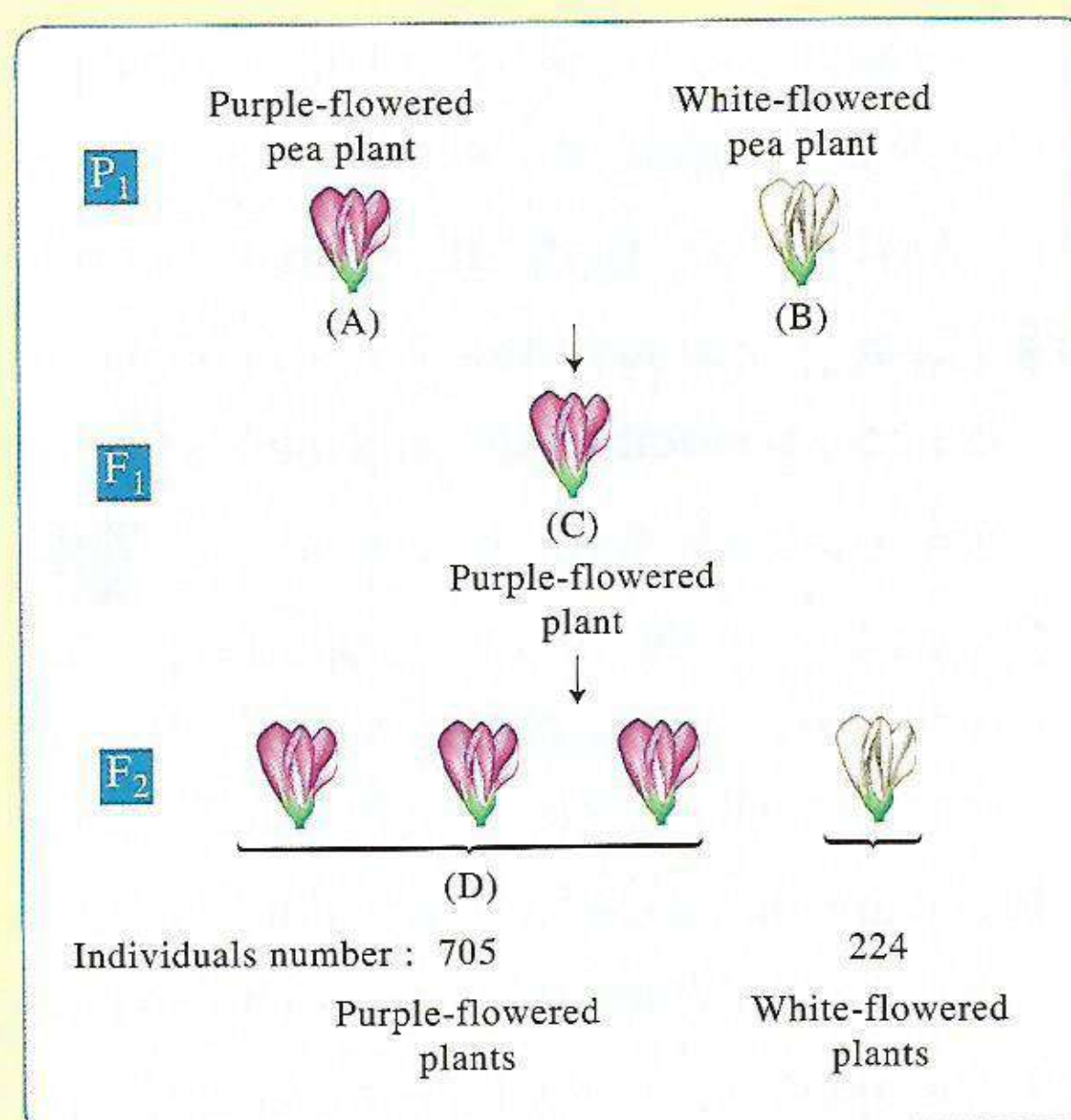
- 2 Examine the opposite figure, then choose the correct answer :

(1) The number of gametes' types produced from (A) is

- (a) one type.
- (b) two types.
- (c) three types.
- (d) four types.

(2) The percentage of the resulting gametes from the individual (C) that carry the recessive gene is

- (a) 25%
- (b) 50%
- (c) 75%
- (d) 100%



(3) The genotype of the produced individuals from crossing (B) plant with (C) plant is

- (a) 100% (aa). (b) 100% (Aa). (c) 50% (aa). (d) 50% (AA).

(4) The number of individuals with the genotype (AA) in group (D) is about

- (a) 176 (b) 235 (c) 470 (d) 528

Mendel's second law : law of independent assortment of genetic factors (explains the inheritance of two pairs of allelomorphic characters)

- When crossing two pure individuals that are different in two pairs or more of different allelomorphic characters (one of them carries two dominant characters in a pure form and the other carries two recessive characters), each pair of these characters is inherited independently, **where** :
 - The two dominant characters appear with 100% in the members of the first generation F_1 .
 - Both the two dominant and two recessive characters appear with a ratio (9 : 3 : 3 : 1) in the members of the second generation F_2 .
- The assortment of genes that are carried on the chromosomes in gametes is independent, because each gene is located on a separate chromosome.

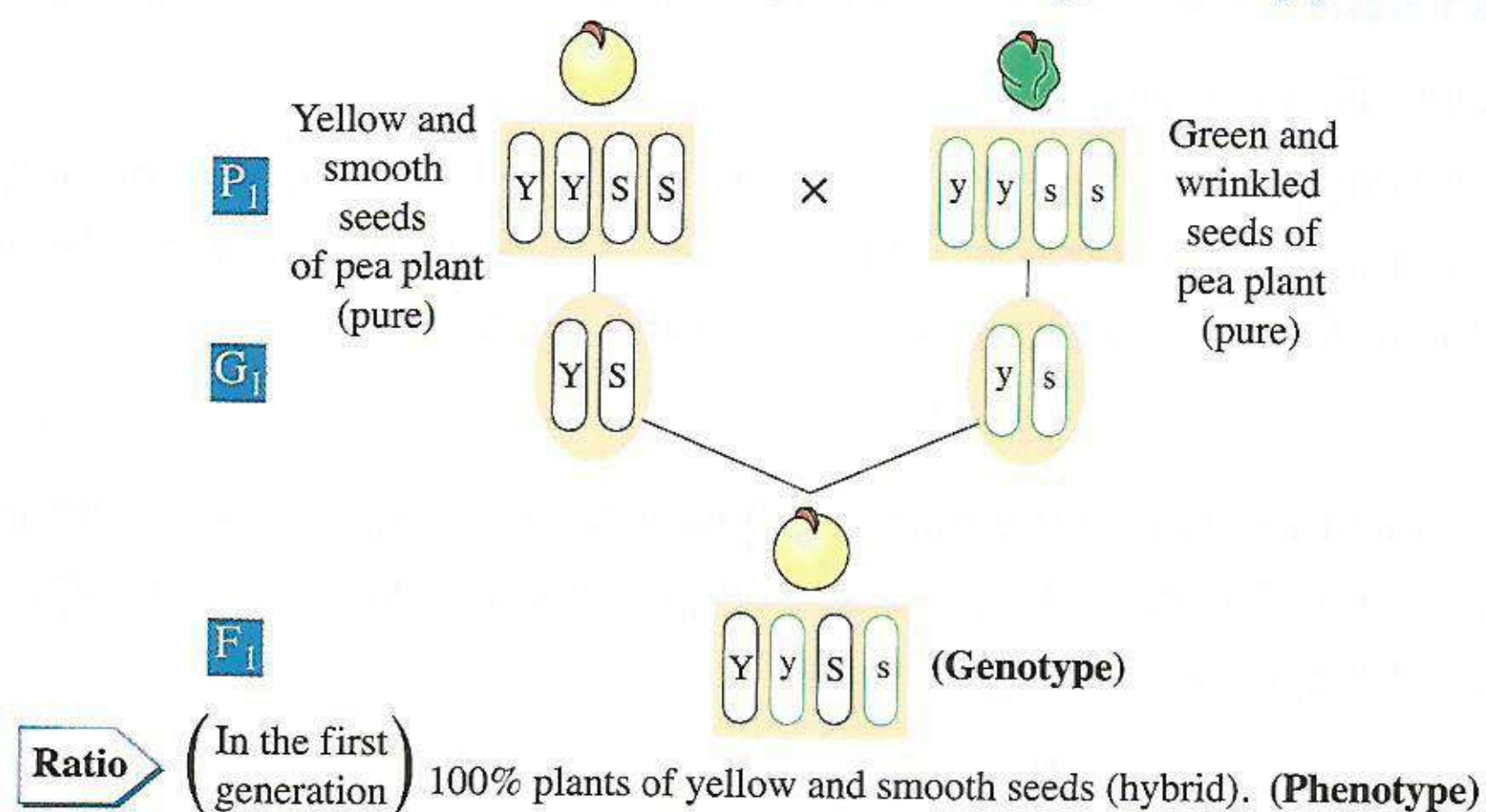
Example

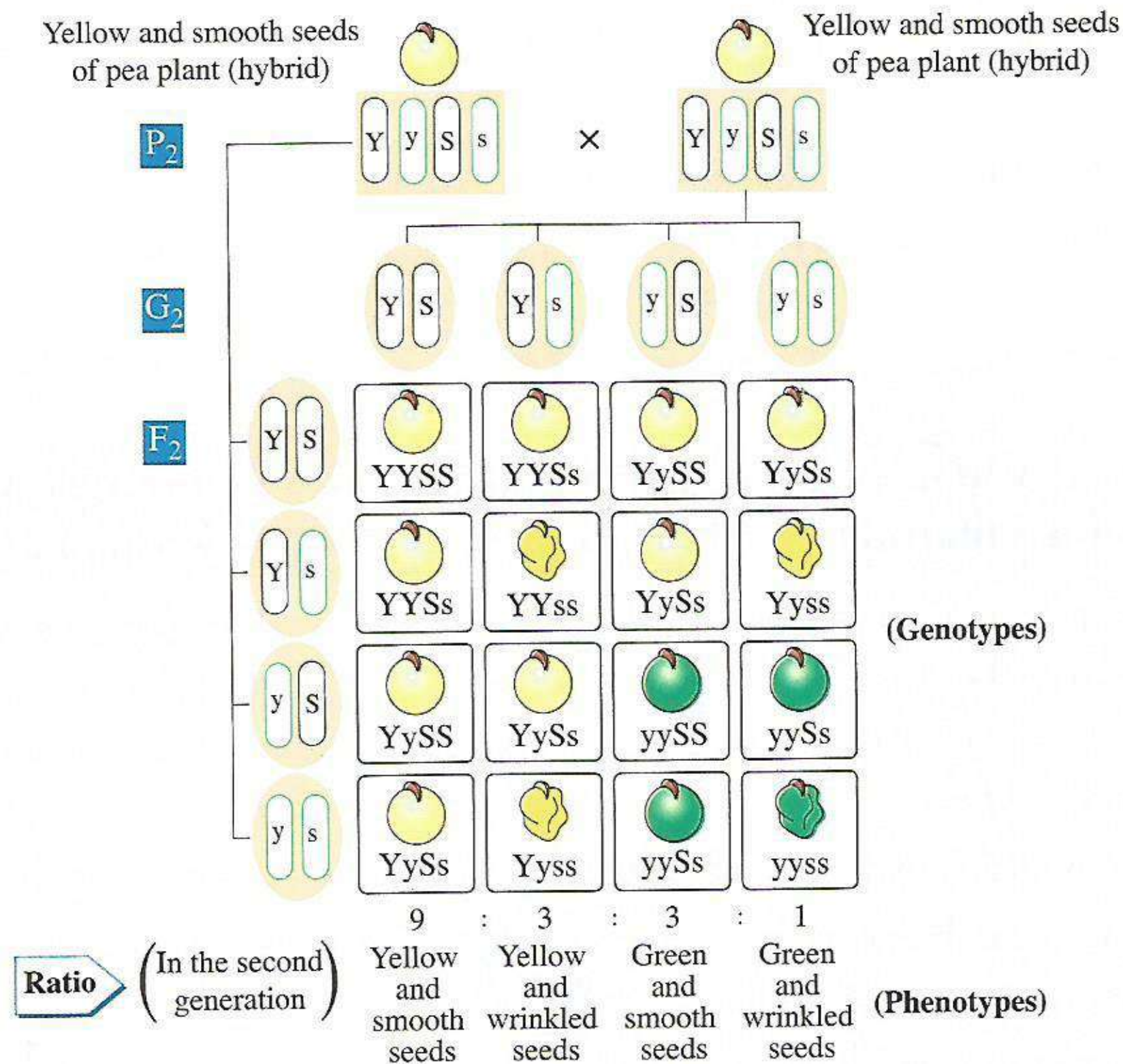
Inheritance of two pairs of characters (inheritance of seeds colour and shape characters in pea plant) :

If you know that :

- The yellow colour gene (Y) of the seeds dominates over the green colour gene (y).
- The gene of smooth-shaped seeds (S) dominates over the gene of wrinkled-shaped seeds (s).

It is possible to express the crossing of a pure yellow and smooth seeds of pea plant with green and wrinkled seeds of pea plant for two generations genetically, as follows :





• From the previous example, we can conclude the following :

- Each of the seed colour gene and the seed shape gene is located on separated chromosome, (i.e. on two different chromosomes). So, the assortment of genes in gametes is independent.
- The members of the first generation carry (bear) the two dominant characters (yellow colour and smooth-shaped seeds) with 100%, while the members of the second generation carry (bear) both the two dominant and two recessive characters (yellow colour and smooth-shaped seeds – green colour and wrinkled-shaped seeds) with a ratio (9 : 3 : 3 : 1).











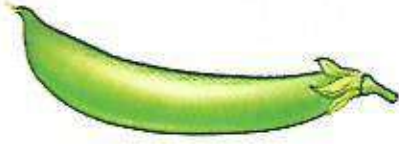
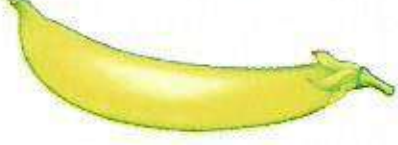
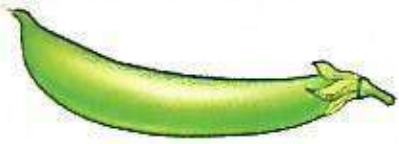
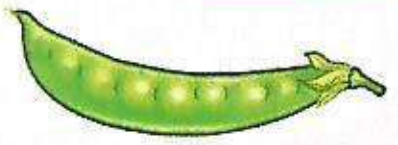
2 Test yourself

Answered

Choose the correct answer :

- When crossing two pea plants, one of them is hybrid purple-flowered and long-stemmed and the other is white-flowered and short-stemmed. So, the percentage of the purple-flowered plants that are resulted from this crossing is
 (a) 25% (b) 50% (c) 75% (d) 100%
- The number of the resulted gametes' types when crossing a long-stemmed plant carrying purple flowers, where its genotype is (TtRr) with another plant carrying two recessive characters is
 (a) 2 (b) 4 (c) 6 (d) 8

★ The following table illustrates the dominant and recessive characters for pea plant that had been studied by Mendel :

Character	Dominant character	Recessive character
Flower's colour	 Purple	 White
Flower position	 Axial	 Terminal
Seed colour	 Yellow	 Green
Seed shape	 Smooth	 Wrinkled
Stem length	 Long	 Short
Pod colour	 Green	 Yellow
Pod shape	 Inflated	 Constricted


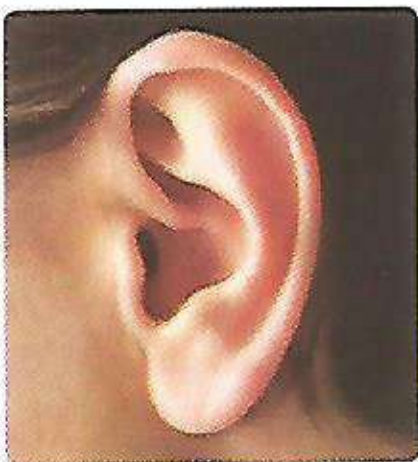




Do you know ...?

- The results of several experiments that had been carried out at the beginning of the last century indicate that Mendel's laws applied to several genetic traits in human, where each trait is controlled by one pair of genes. If an individual inherits :

A dominant gene → at least from one parent, the dominant character appears on the individual.

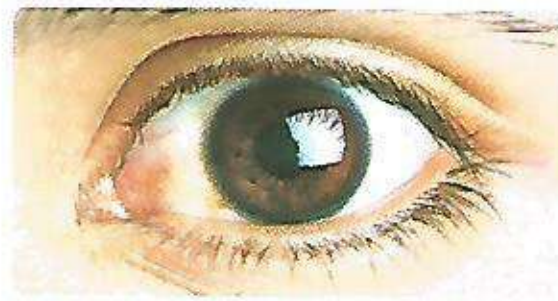
A recessive gene → from both parents, the recessive character appears on the individual.

★ The following table illustrates some human characters that obey the principle of complete dominance :

Character	Dominant character	Recessive character
<p>1</p> <p>Tongue rolling</p>	 <p>Ability to roll the tongue</p>	 <p>Inability to roll the tongue</p>
<p>2</p> <p>Earlobe</p>	 <p>Detached earlobe</p>	 <p>Attached earlobe</p>
<p>3</p> <p>Hair texture</p>	 <p>Curly hair</p>	 <p>Straight hair</p>
<p>4</p> <p>Hair colour</p>	 <p>Black hair</p>	 <p>Light hair</p>
<p>5</p> <p>Eye size</p>	 <p>Wide eyes</p>	 <p>Narrow eyes</p>

6

Eye colour



Brown eyes



Coloured-eyes
(Blue - Green - Grey)

7

Face
dimples



Presence of dimples



Absence of dimples

8

Face
freckle



Absence of freckle



Presence of freckle

Mendel's Laws According to the Chromosomal Theory



Interactive test

The questions signed by measure the high levels of thinking.

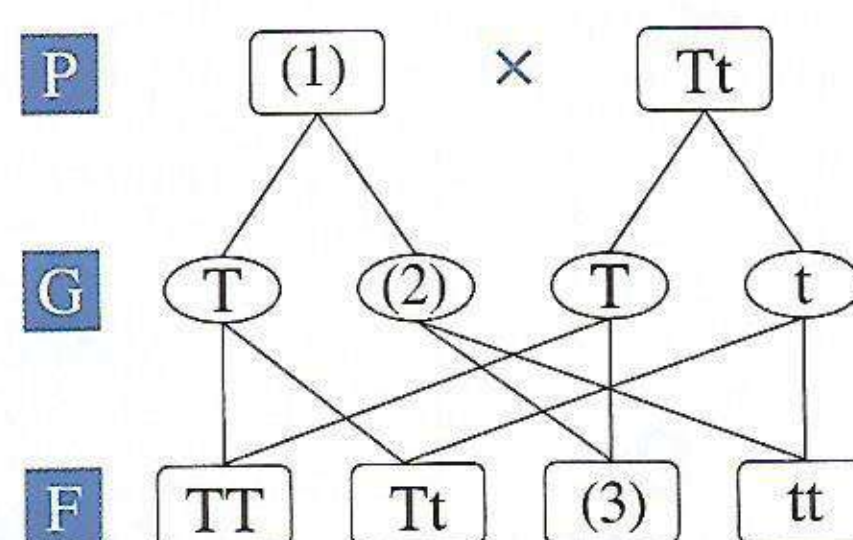
First

Multiple Choice Questions

- 1 The scientist Mendel had reached after his experiments on the green pea plant that
- (a) the single chromosome may carry hundreds of genes.
 - (b) the gene is responsible for the appearance of a specific character.
 - (c) the character is controlled by a pair of genetic factors.
 - (d) the gene is formed of a sequence of nucleotides.

- 2 In the opposite diagram that illustrates a self-pollination in a long-stemmed pea plant, which of the following indicates the numbers (1), (2) & (3) respectively ?

	(1)	(2)	(3)
(a)	TT	T	tt
(b)	Tt	t	Tt
(c)	Tt	T	TT
(d)	tt	t	TT



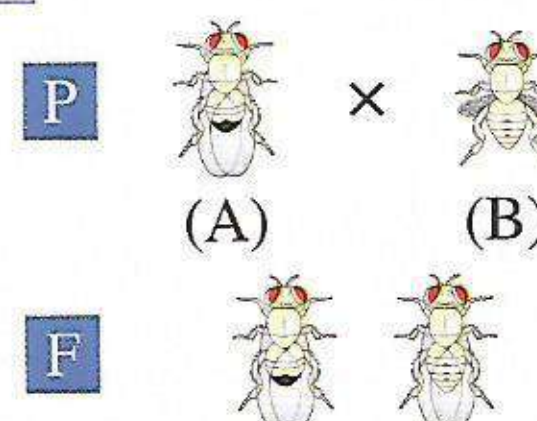
- 3 When a crossing was carried out between a plant whose genotype is (BB) with another one whose genotype is (bb), 150 individuals were produced. So, the number of the produced individuals whose genotype is (Bb) is individuals.

(a) 30 (b) 65 (c) 75 (d) 150

- 4 The purple-coloured flowers character appears in pea plant with two genotypes which are

(a) (RR) and (rr). (b) (RR) and (Rr). (c) (RR) and (RW). (d) (Rr) and (rr).

- 5 The opposite figure shows the inheritance of long wings character in an insect and the resulted generation from crossing insects (A) and (B), we can deduce that

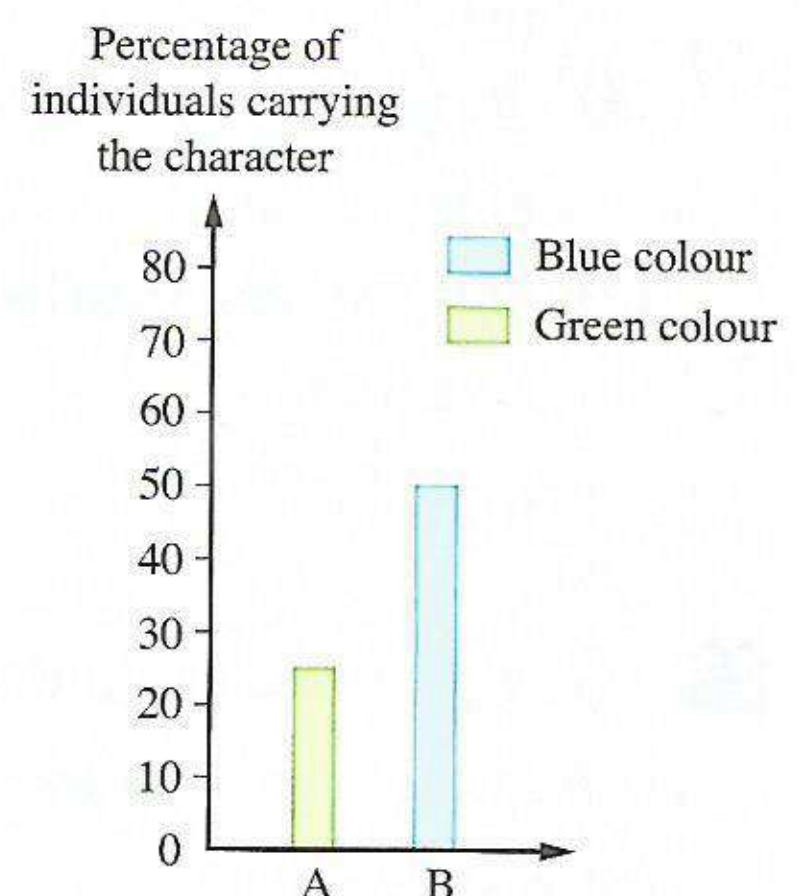


- (a) the gene of the character in insect (B) dominates over the gene of the character in insect (A).
- (b) the gene of the character in insect (A) dominates over the gene of the character in insect (B).
- (c) there is no dominance between the genes of the character in both insects (A) and (B).
- (d) the character's gene in insect (B) completes the work of the character's gene in insect (A).

- 6 A male and female with genotype (Aa) were married, the possibility of presence of the genotype (AA) among their offspring may be
- (a) 25% (b) 50% (c) 75% (d) 100%
- 7 If the genotype of a character of a child is (aa), which of the following can represent the genotypes of the parents for this character ?
- (a) (AA) × (Aa). (b) (AA) × (AA). (c) (Aa) × (aa). (d) (AA) × (aa).
- 8 When crossing pea plants with purple flowers (Rr), the percentage of the appearance of purple flowers in the resulted generation is
- (a) 100% (b) 75% (c) 25% (d) 0%
- 9 Through Mendel's experiments, it can be concluded that [Choose two answers]
- (a) the dominant character is appeared with two genotypes.
 (b) the recessive character is appeared with two phenotypes.
 (c) the dominant character is always pure.
 (d) the recessive character is appeared in all generations.
 (e) the allelomorphic characters are expressed by two phenotypes.
- 10 When crossing two pea plants, one of them carries pure purple flowers and the other carries white flowers. So, the percentage of the resulted generation is
- (a) 100% purple flowers.
 (b) 75% purple flowers : 25% white flowers.
 (c) 50% purple flowers : 50% white flowers.
 (d) 100% white flowers.

- 11 In a type of fish, a crossing between blue-coloured male and female takes place, from the opposite graph, which of the following illustrates the genotypes of individuals (A) and (B) that are resulted from this crossing ?

	(A)	(B)
(a)	bb	bb
(b)	Bb	BB
(c)	bb	Bb
(d)	BB	Bb

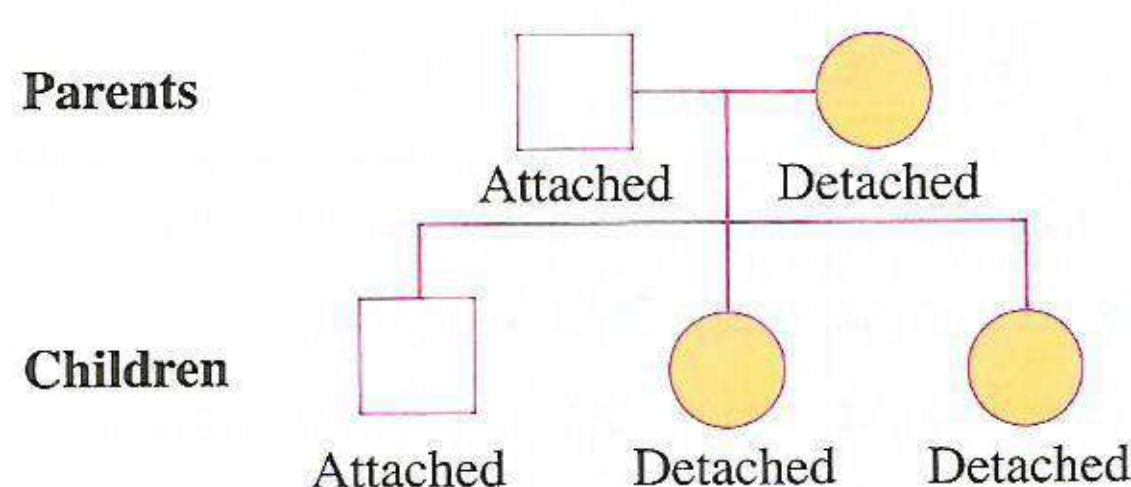


- 12 If you know that the character of albinism is characterized by the absence of melanin pigment from skin, hair and eyes, where this character is a recessive mendelian character in human, when mating an albino man with a woman carrying the gene of albinism.

So, the possibility of the appearance of this character in the offspring is

- (a) 25% (b) 50% (c) 75% (d) 100%

- 13 The shape of a person's earlobes is determined by a single gene. This gene has dominant and recessive alleles. The allele for detached earlobes is dominant over the allele for attached earlobes. The following diagram shows the inheritance of earlobe shape in a family :



What is the probability of the next child from the same parents to have detached earlobes ?

- (a) 0% (b) 25% (c) 50% (d) 75%

- 14 A woman suffers from the upper eyelid relaxant, where this trait depends on the presence of a dominant gene (E), the woman's father had this trait but her mother was normal. In the light of this, answer the following :

(1) The genotype of this woman is

- (a) Ee (b) EE (c) ee (d) (a) or (b).

(2) The genotype of her father is

- (a) Ee (b) EE (c) ee (d) (a) or (b).

(3) The genotype of her mother is

- (a) Ee (b) EE (c) ee (d) (a) or (b).

(4) If this woman married to a normal man, the expected percentage of the offspring with this trait is

- (a) 100% (b) 75% (c) 50% (d) 25%

- 15 The appearance of children with narrow eyes for parents having wide eyes, this indicates that the genotypes of the parents are

- (a) AA × AA (b) AA × aa (c) aa × aa (d) Aa × Aa

- 16** If you know that the green pod colour gene of the pea plant dominates over the yellow pod colour gene :
- (1) When crossing two pea plants with green pods (hybrid), the percentage of plants with yellow pods in the resulted generation is
- (a) 100% (b) 75% (c) 50% (d) 25%
- (2) The character of yellow pod colour in pea plant is appeared from all the following crossings, except
- (a) $GG \times Gg$ (b) $Gg \times Gg$ (c) $Gg \times gg$ (d) $gg \times gg$
-
- 17** From the opposite table, which of the following is not from the genetic possibilities of the resulted generation ?
- (a) AaBb (b) AaBB
(c) aabb (d) Aabb
- | | | |
|--------|----|----|
| Sperms | AB | Ab |
| Ova | ab | aB |
-
- 18** The percentage of gametes from the type (Ab) that are produced by an individual with genotype (Aabb) is
- (a) 25% (b) 50% (c) 75% (d) 100%
-
- 19** If the percentage of gametes from the type (ab) in an individual is 100%, the genotype of this individual is
- (a) AaBb (b) AABB (c) Aabb (d) aabb
-
- 20** A person with genotype (GgHH), which of the following is correct with respect to the produced gametes ?
- (a) 25% (gH). (b) 50% (gH). (c) 75% (GH). (d) 100% (GH).
-
- 21** When crossing two pea plants, one of them has hybrid smooth seeds and the other has wrinkled seeds. So, the percentage of smooth seeds in the resulted generation is
- (a) 100% (b) 75% (c) 50% (d) 0%
-
- 22** The number of gametes types that are produced from a person whose genotype is (AaBb) is type(s).
- (a) one (b) two (c) three (d) four
-
- 23** If the genotype of a person is (BBRr), all the resulted gametes always carry
- (a) two dominant genes. (b) two recessive genes.
(c) one dominant gene. (d) one recessive gene.

24 When crossing two pea plants, one of them has yellow smooth-shaped seeds and the other has green wrinkled-shaped seeds. All the resulted individuals have yellow smooth-shaped seeds. In the light of this, answer the following :

(1) The genotype of the resulted individuals is

- (a) YySs (b) YySS (c) yySs (d) Yyss

(2) When a crossing takes place among the individuals of the first generation, the percentage of the resulted individuals carrying the same phenotypes and genotypes of the parents is

- (a) 0% (b) 25% (c) 50% (d) 75%

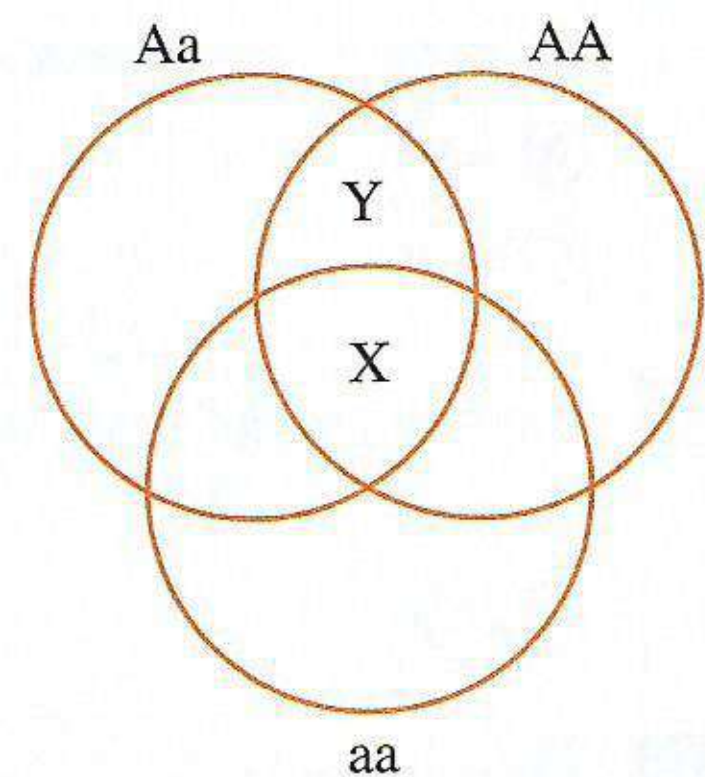
25 Study the opposite figure, then answer :

(1) The symbol (X) represents

- (a) the number of alleles for each genetic trait.
 (b) the appearance of the trait in the first generation.
 (c) the presence of the trait on the same chromosome.
 (d) the location of the trait on the same chromosome.

(2) The symbol (Y) represents

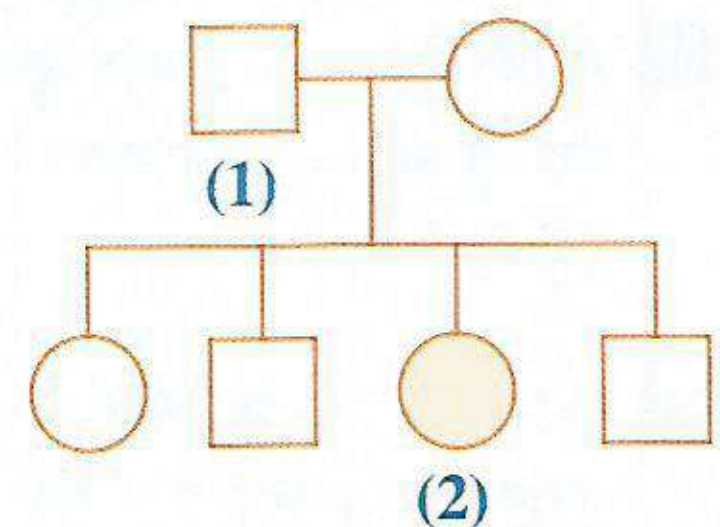
- (a) the purity of the trait.
 (b) the similarity of phenotypes.
 (c) the similarity of genotypes.
 (d) the similarity of alleles.



26 The opposite diagram shows a parentage record for crossing a man and a woman, both of them have brown eyes, one of the children appeared with blue-coloured eyes, if you know that the brown eyes gene (B) is dominant over the blue eyes gene (b), and the square represents male, circle represents female and the shaded shape represents the recessive character carrier. In the light of this, conclude :

The genotypes of individuals (1) and (2) are

- (a) BBXX (b) BBXY (c) BbXX
 (d) BbXY (e) bbXX



[Choose two answers]

27 If you know that the natural skin colour gene is symbolized by (A) and the albino skin gene is symbolized by (a), which of the following crossings produce a half of offspring carrying the dominant character in a hybrid form ?

[Choose two answers]

- (a) AA × aa (b) AA × AA (c) Aa × Aa
 (d) AA × Aa (e) aa × aa

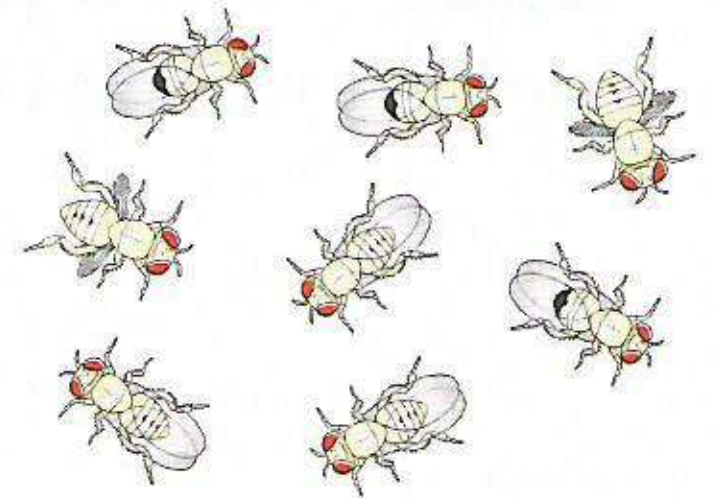
Second Miscellaneous Questions

1 Explain : in Mendel's experiments on the colour of the green pea plant flowers, the plants of the first generation didn't carry white flowers.

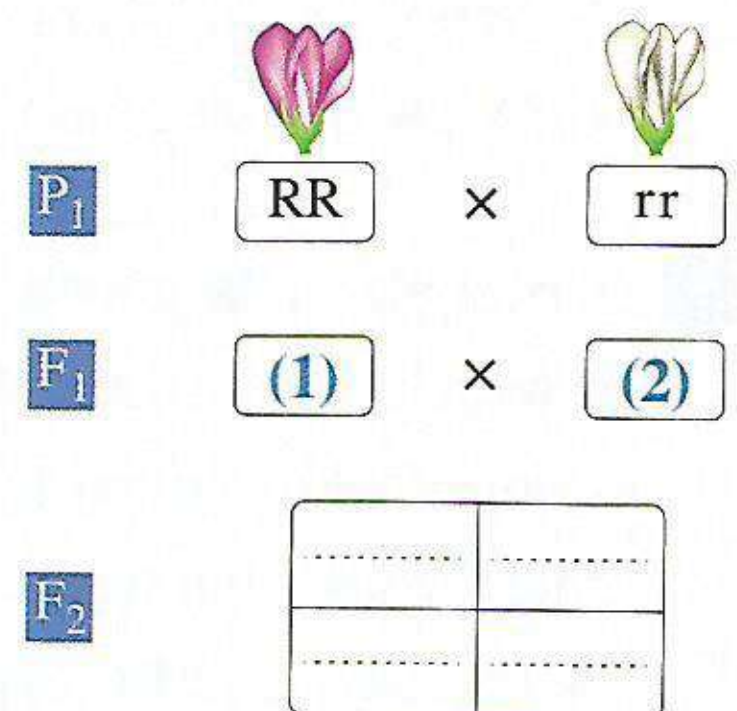
2 What is the meaning of each of the following statements :

- (a) All the offspring's individuals carry the character of one parent when crossing two individuals that differ in a pair of allelomorphic characters.
- (b) The number of axial flowers is 3 times more than the number of terminal flowers in pea plant with respect to the main seedlings shape.

3 The opposite figure shows the resulted individuals from the crossing of a male and a female of *Drosophila* insect, both of them carry long wings, **explain** the reason for the appearance of a new character in the resulted individuals, **and what** is the percentage of the appearance of this character among all the resulted individuals of the generation ?



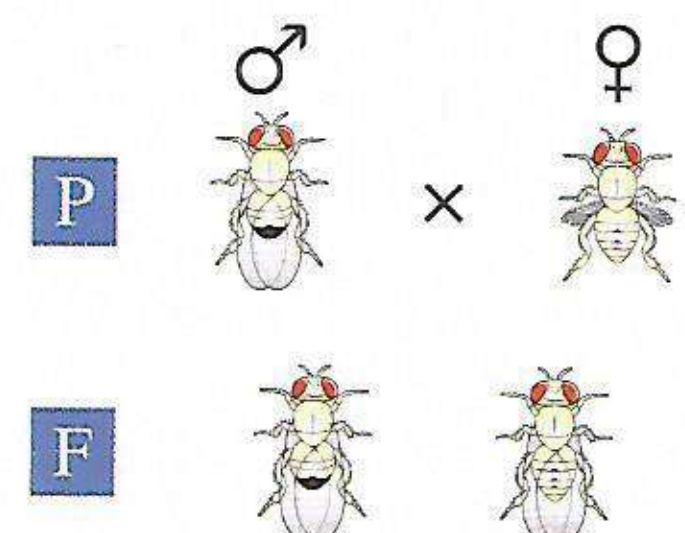
4 The opposite figure shows the crossing of two pea plants, where one of them is purple-flowered and the other is white-flowered :



- (a) Write the genotypes and phenotypes of individuals no. (1) and (2).
- (b) What are the pure genotypes in the second generation ?
And what is their percentage ?

**5 "In complete dominance, the dominant character appears with 50% in the second generation when one pair of pure allelomorphic characters is inherited".
How far this statement is correct ? With explanation.**

6 The opposite figure shows the resulted generation from crossing two *Drosophila* insects, the male has long wings and the female has short wings, knowing that (T) is the symbol for long wings gene. **In the light of this, determine :**



- (a) The genotypes for the parents of the second generation.
- (b) The percentage of long and short-winged individuals in the second generation.

7 ✎ When a crossing takes place between a yellow smooth seeds of pea plant with another plant having green wrinkled seeds, the numbers of plants in the resulted generation were, as follows :

- 265 yellow smooth seeds.
- 273 yellow wrinkled seeds.
- 258 green smooth seeds.
- 264 green wrinkled seeds.

In the light of the previous results, what are the expected genotypes of the parents ?

8 The following table shows the genetic analysis for crossing a brown long-horned ox with a white short-horned cow, knowing that (B) is the brown colour gene which dominates over the white colour gene (b) and the long horn gene (M) dominates over the short horn gene (m) :

♀ \ ♂	BM	...(1)...	bM	...(2)...
bm	...(3)...	Bbmm	...(4)...	...(5)...

- (a) Write the gametes of no. (1) and (2).
- (b) What are the phenotypes of the individuals no. (3) and (5) ?
- (c) What are the genotype and phenotype of the individual no. (4) ?

9 In beet plant, the genetic factor of swollen roots (M) is dominant over the genetic factor of weak roots (m), and the genetic factor of red colour (R) is dominant over the genetic factor of white colour (r). **Deduce the genotypes and phenotypes** that are resulted from the crossing of two plants having the genotypes (Mmrr) and (MmRr), **illustrating** the percentage of the appearance of plants with white swollen roots.

Chromosomes and Genetic Information



Choose the correct answer (1 : 10) :

1 The opposite figure represents the karyotype of a

- (a) human sperm.
- (b) human ovum.
- (c) skin cell of a human male.
- (d) stomach cell of a human female.

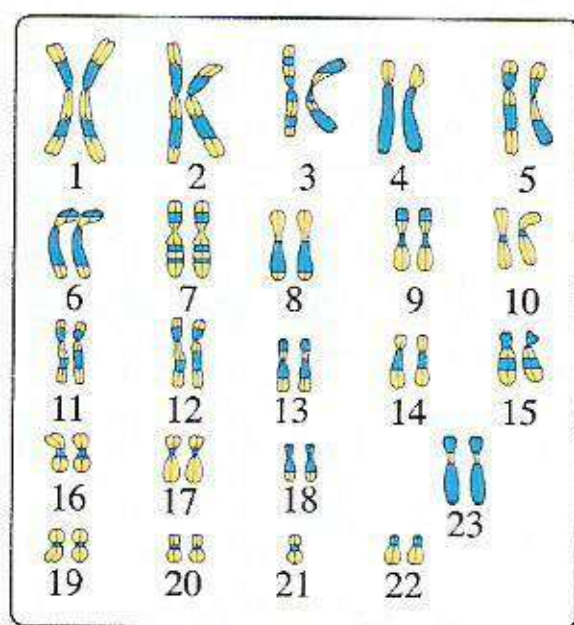
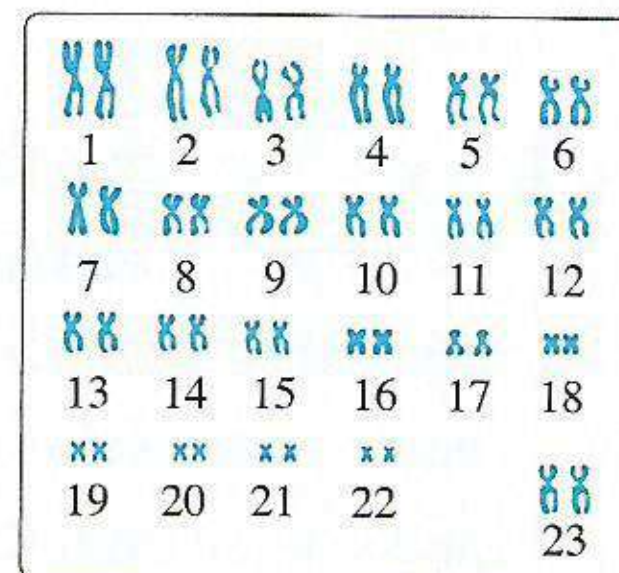


Figure (1)

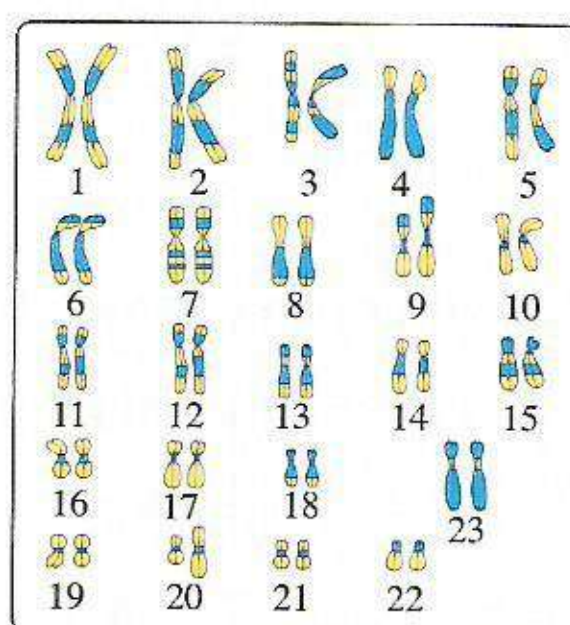


Figure (2)

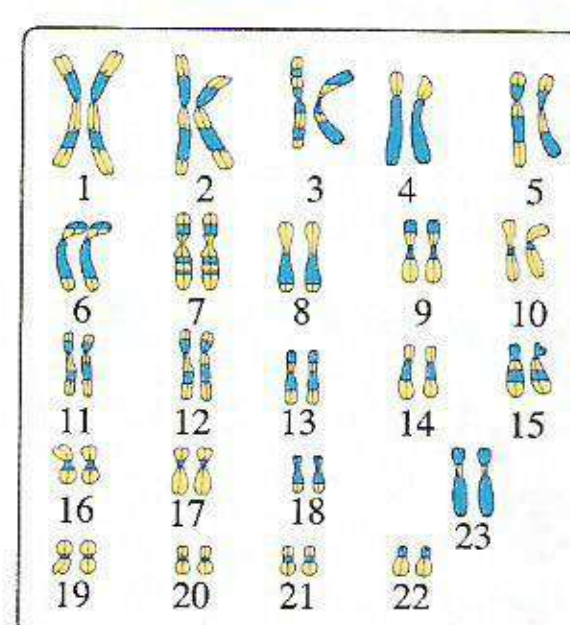


Figure (3)

2 Which of the previous three figures represent(s) a normal human female ?

- (a) Figure (1).
- (b) Figure (2).
- (c) Figure (3).
- (d) Figure (2) and figure (3).

3 Which of the previous three figures contain(s) some asymmetric pairs of chromosomes ?

- (a) Figure (1).
- (b) Figure (2).
- (c) Figure (3).
- (d) Figure (2) and figure (3).

4 The least number of chromosomes found in

- (a) figure (1).
- (b) figure (2).
- (c) figure (3).
- (d) figure (2) and figure (3).

5 If a mitotic division, meiotic division, then fertilization occurred in a cell, the stages which the cell passes are

a $n \rightarrow 2n \rightarrow 2n \rightarrow n$

b $2n \rightarrow 2n \rightarrow n \rightarrow 2n$

c $2n \rightarrow n \rightarrow n \rightarrow 2n$

d $n \rightarrow n \rightarrow 2n \rightarrow 2n$

6 If you know that the long wings gene is dominant over the short wings gene in *Drosophila* insect, when a crossing occurs between a long-winged male and a short-winged female, all the resulted individuals were long-winged. Based on that, the percentage of short-winged individuals in the resulted offspring from crossing a male and female from the first generation is

a 25%

b 50%

c 75%

d 100%

7 If you know that the number of chromosomes in a human skin cell equals (X). So, the number of autosomes in a stomach cell equals

a X

b $X - 1$

c $X - 2$

d $2X$

8 All the following statements are incorrect about the gene, except that it consists of

a a number of DNA molecules.

b a sequence of nucleotides.

c protein and DNA

d proteins that determine the appearance of the genetic trait.

9 The gametes percentage from the type AB for the genotype (AABb) represents about

a 25%

b 50%

c 75%

d 100%

- 10 According to the following table, the chromosomal structure (genotype) for individual no. (1) is

- (a) AaBb
(b) aaBb
(c) AABb
(d) aabb

♀ \ ♂		Ab		ab
Ab	AABb		AaBb	Aabb
		Aabb	(1)	

Answer the following questions (11 : 17) :

- 11 In the light of your study, what are the similarities and differences between :

	The sperm in human	The ovum in human
Similarities :		
Differences :		

- 12 Complete the following table :

♀ \ ♂	AB	
aB		AaBb
	AaBb	

- 13 "The recessive genetic trait is always appeared in the individuals of the resulted generations". How far this statement is correct ? With explanation.

14 What happens if : the gametes are formed in a plant by mitotic division ?

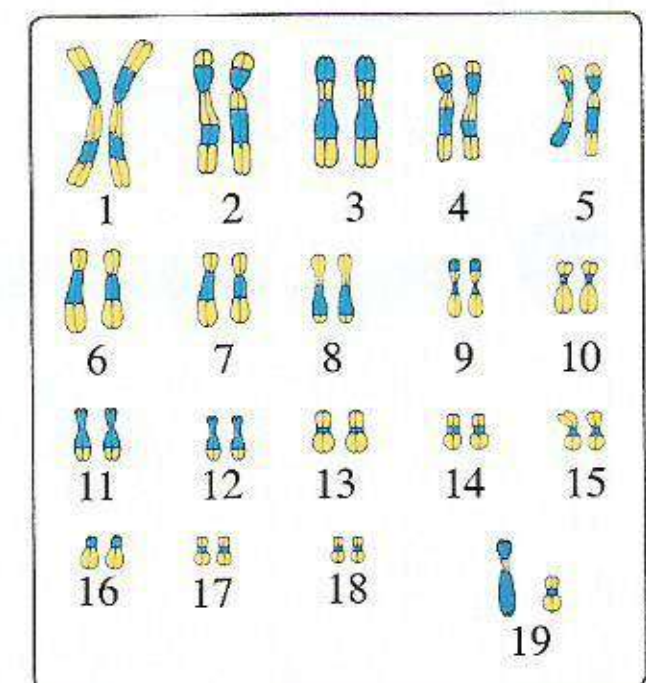
Explain your answer.

15 What is the percentage of purple-flowered plants that are resulted from crossing a purple-flowered pea plant (hybrid) with a white-flowered one ?

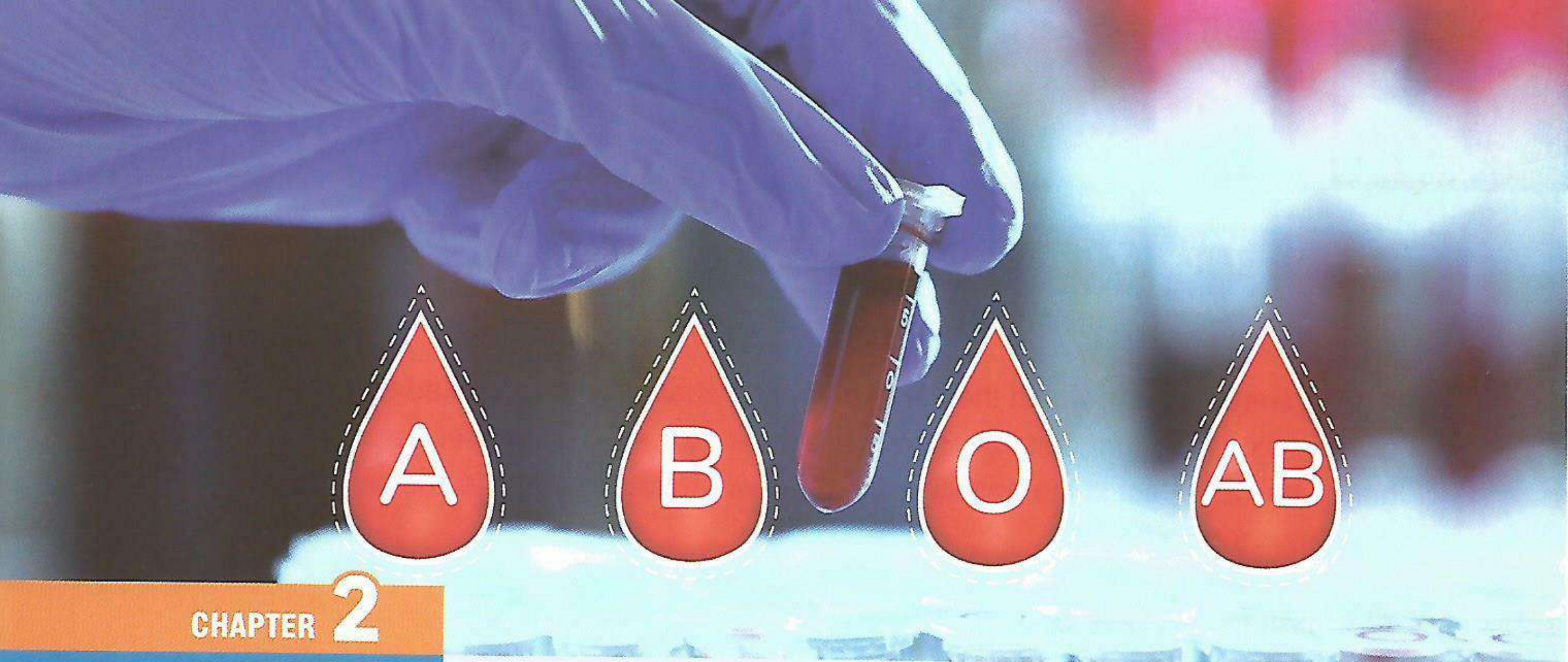
16 The opposite figure shows the karyotype of a living organism that resembles the human in sex determination :

(a) What is the sex of this organism ? And why ?

(b) Is this cell somatic or sex cell ? And why ?



17 What is the colour of the flowers resulted from crossing two white-flowered pea plants ?



CHAPTER 2

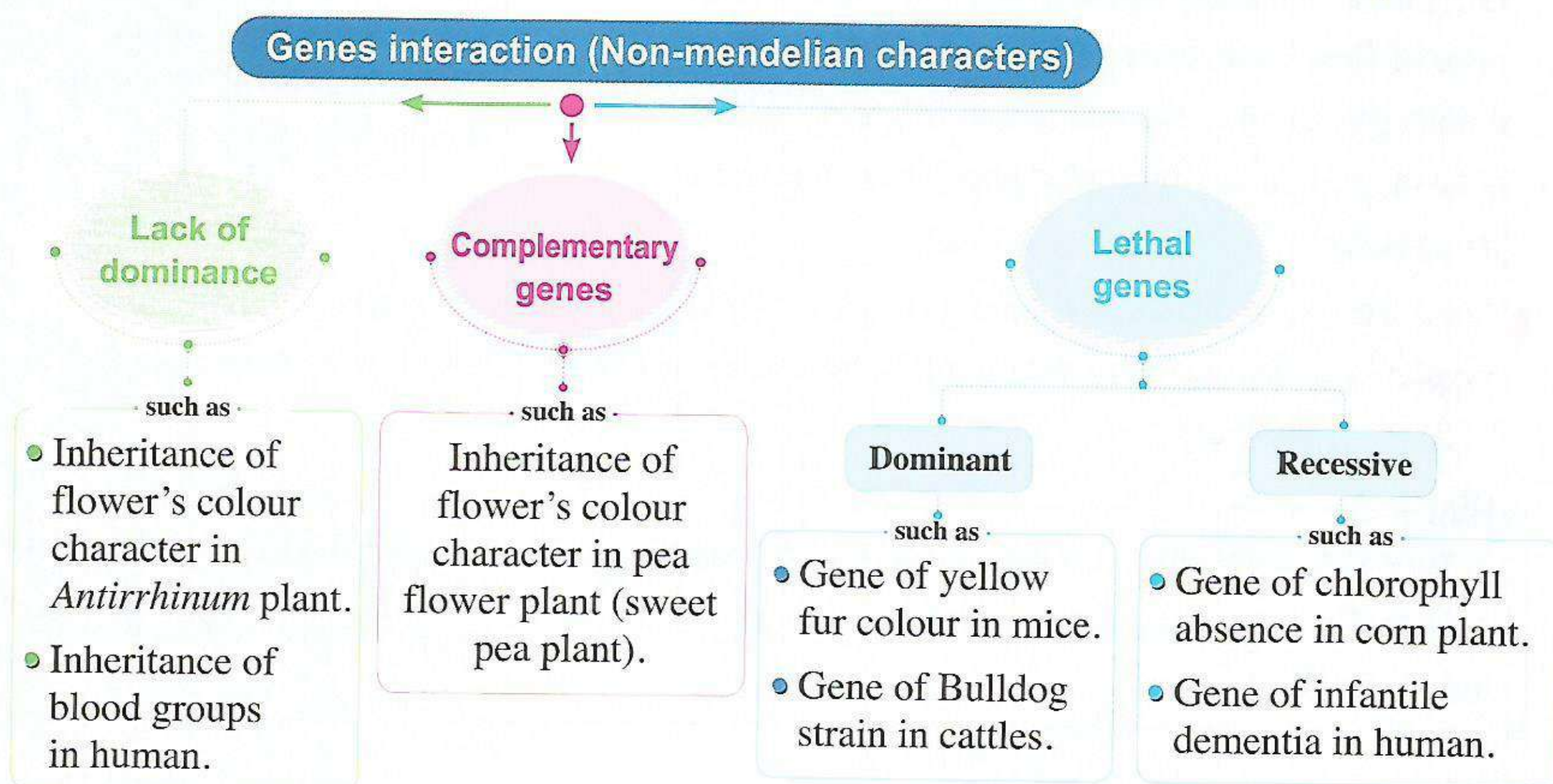
LESSON ONE

Genes Interaction (Lack of Dominance)

• You had known previously that :

The characters that obeyed Mendel's laws (Mendelian characters) are complete dominance characters, because the genetic factor (gene) of the dominant character dominates over the genetic factor of the recessive one and obscures its effect completely, such as the flower's colour and seeds colour and shape in green pea plant, but by the continuous observations and carrying out experiments on other plants and animals, it was found that some of their characters were not inherited according to Mendel's laws and called **non-mendelian characters**. They include cases in which the appearance of genetic traits is affected by the interaction of genes.

• We will study some of these genetic cases that are shown in the following diagram :



First

Lack of dominance

Lack of dominance

It is a genetic case in which the inheritance of a character is controlled by a pair of genes, where no one of them dominates over the other, as each one of these allelomorphic genes has an effect in the appearance of a new character and this happens due to the genes interaction.

• The ratio in this case is :

- In 1st generation (F_1) : 100% new character.

- In 2nd generation (F_2) :

1	:	2	:	1
Character of one parent		New character		Character of the other parent

Examples

A Inheritance of flower's colour character in *Antirrhinum* plant.

B Inheritance of blood groups in human.

A Inheritance of flower's colour character in *Antirrhinum* plant

- When crossing a red-flowered plant (RR) with a white-flowered plant (WW), the plants of the first generation (F_1) are purple-flowered (RW) with 100% **i.e.** A new character appears, where the red colour gene of flowers doesn't dominate over the white colour gene, due to the interaction of genes, as each gene of the two allelomorphic genes has an effect in the appearance of the new character.

Note

The characters genes in the lack of dominance case are symbolized by capital letters, because no character dominates over the other.

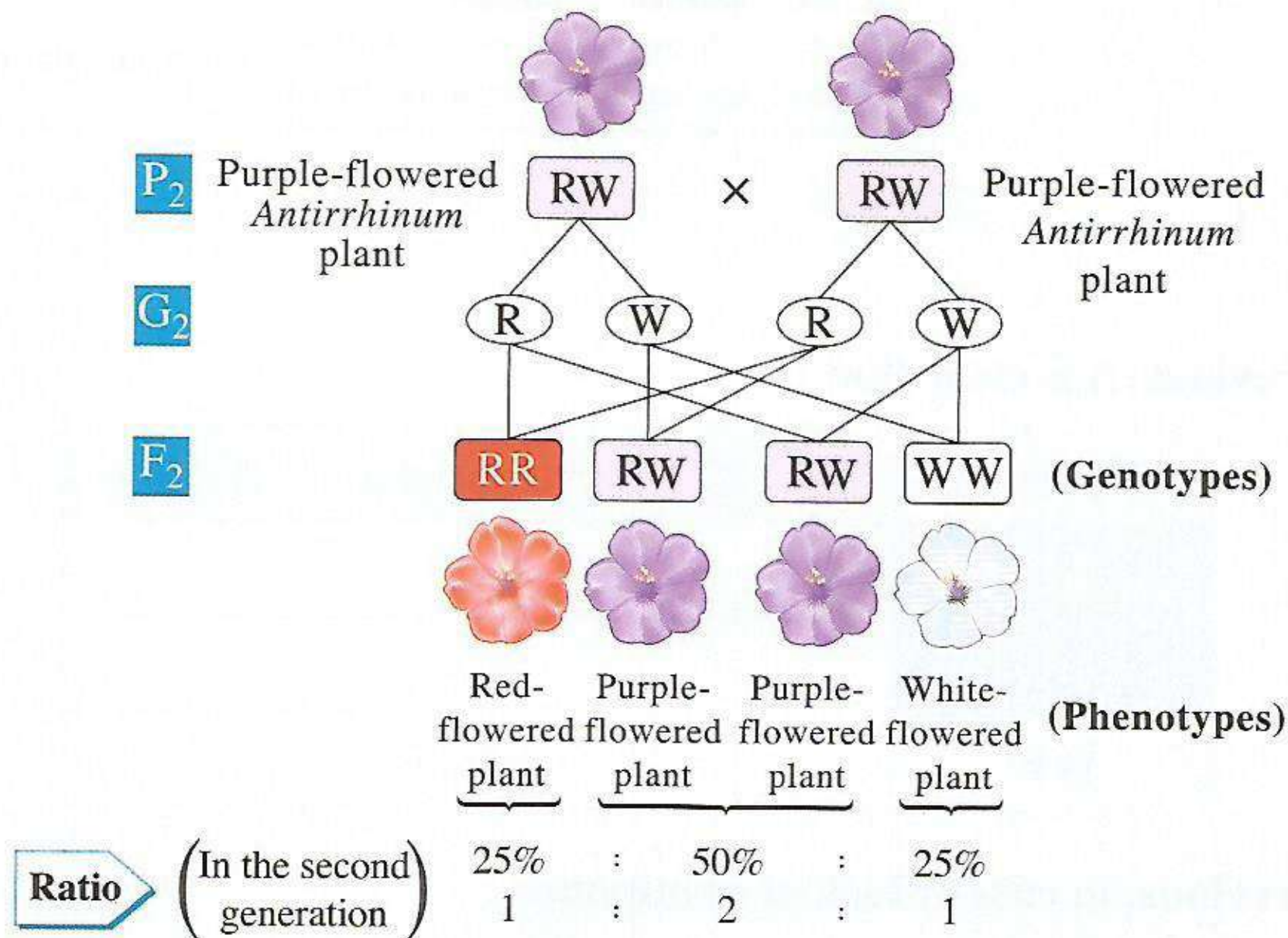
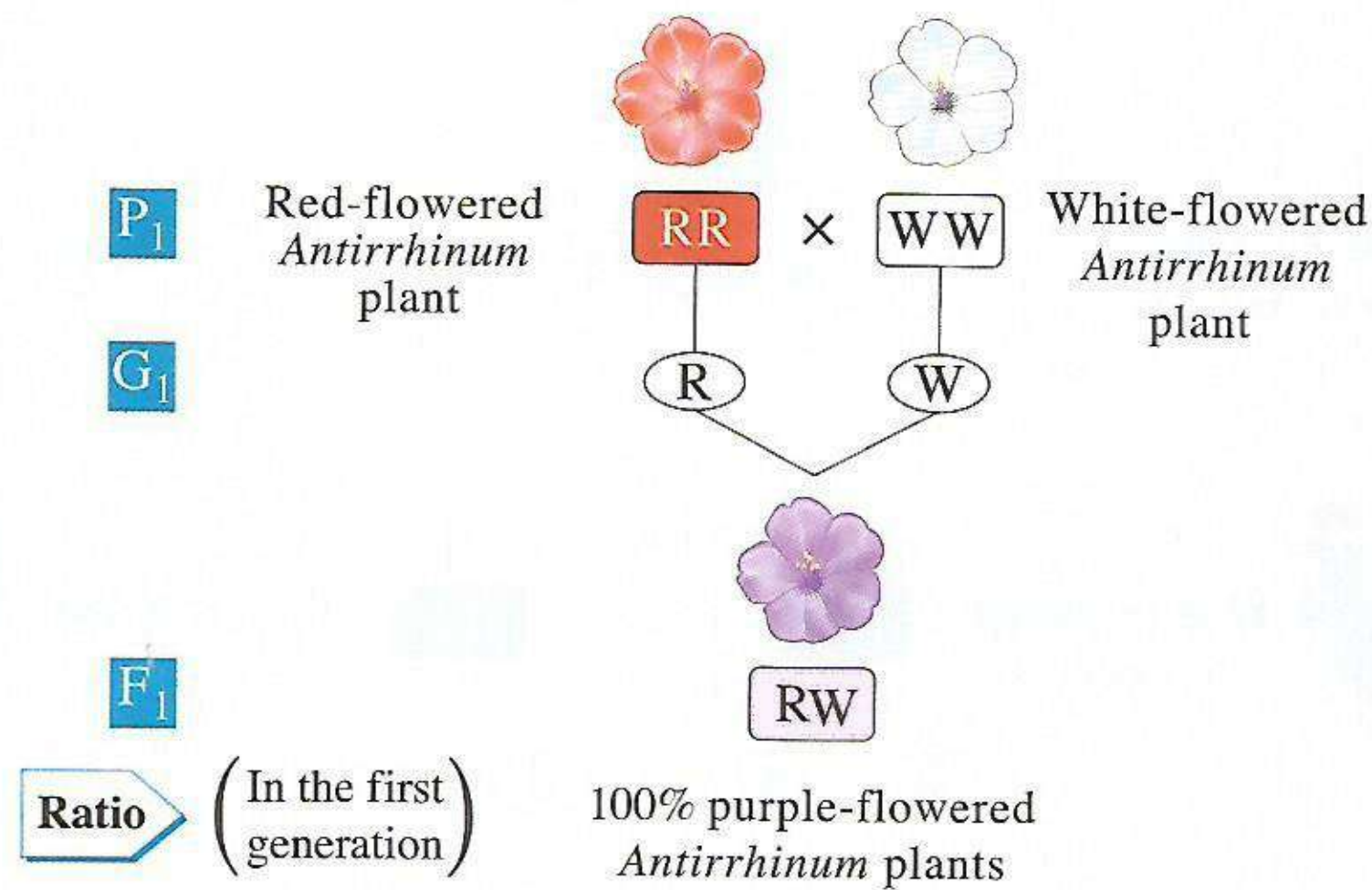
- When the plants of the first generation are self-pollinated and their seeds are cultivated, the plants of the second generation (F_2) have red, purple and white flowers with a ratio 1 : 2 : 1 respectively.

Hint

In scientific references, it is mentioned that crossing a red-flowered *Antirrhinum* plant with a white-flowered one will produce a generation of pink-flowered plants not purple as mentioned in the text.

For illustration only

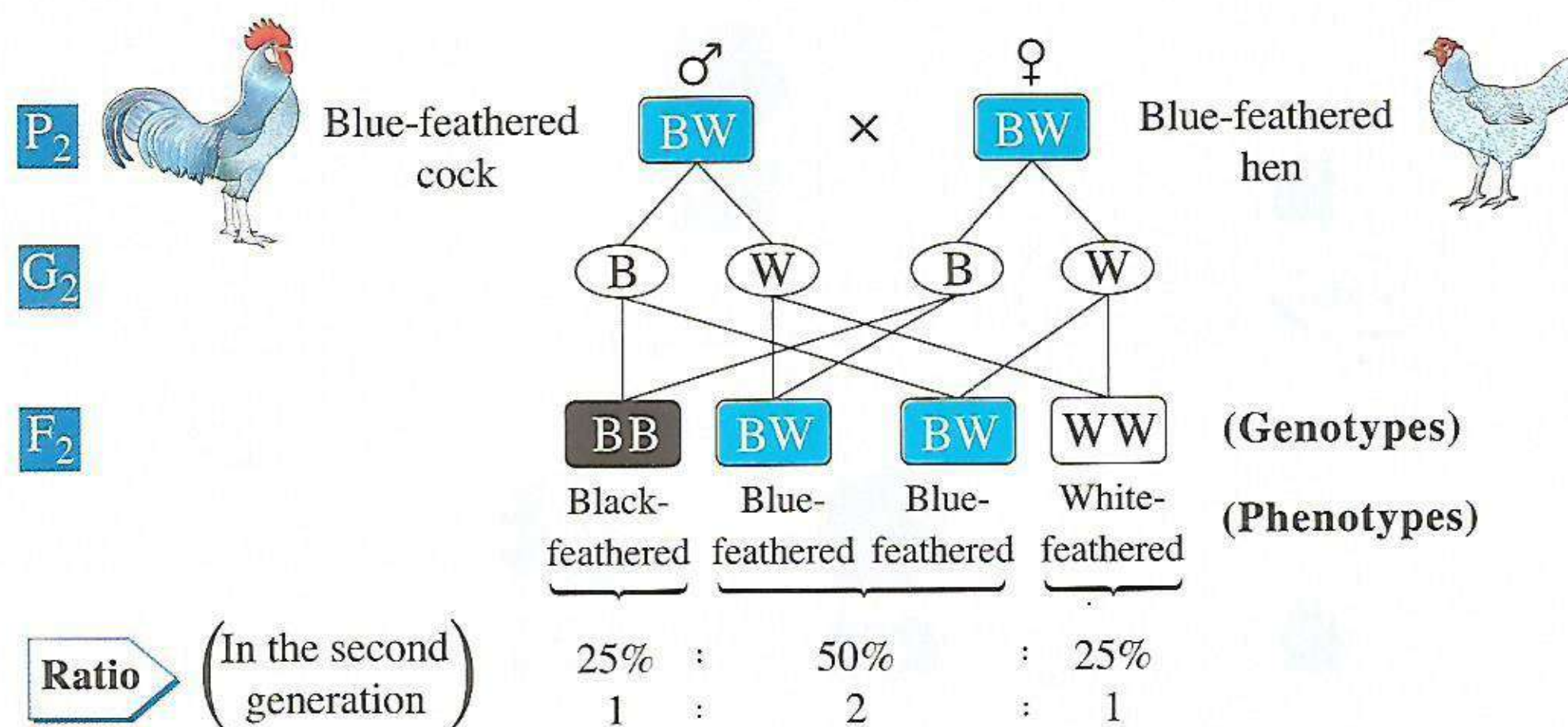
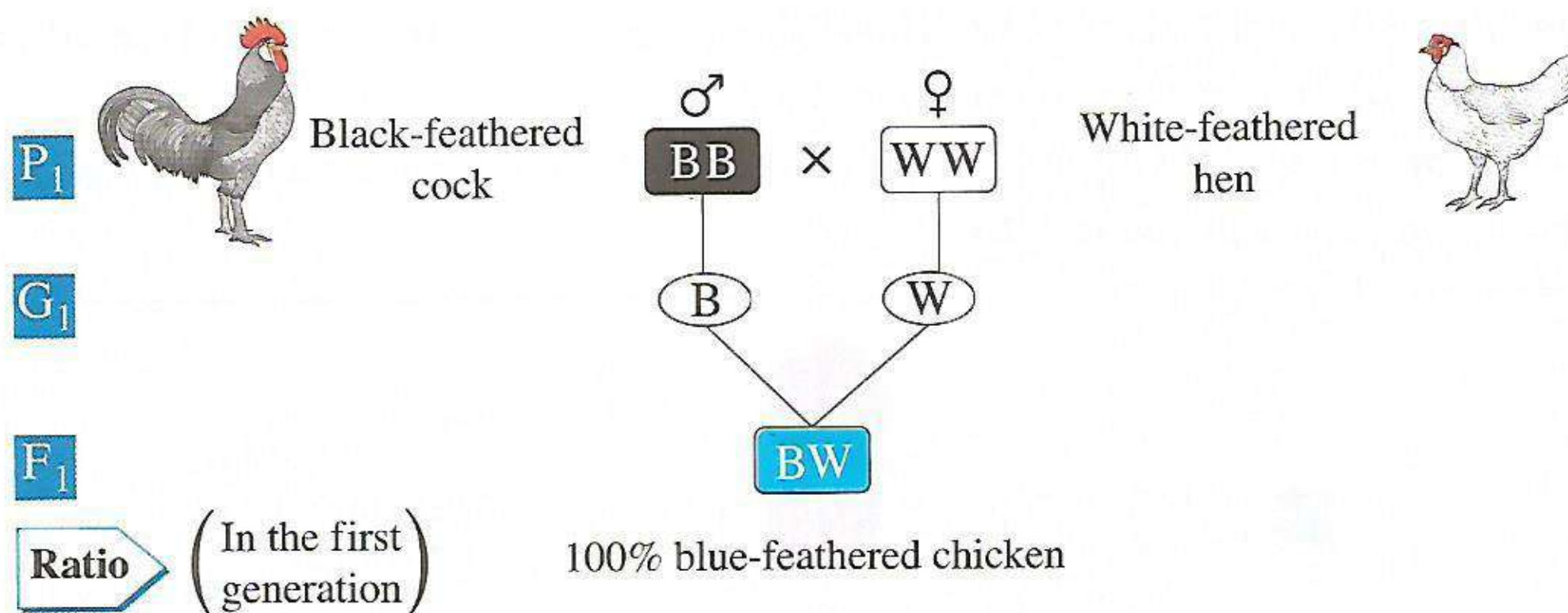
- **Self-pollination** : is the transfer of pollen grains (male gametes) from the anther of a flower to the stigma of the same flower, or to the stigma of another flower on the same plant.
- **Cross-pollination** : is the transfer of pollen grains from the anther of a flower on a plant to the stigma of a flower on another plant of the same species.



Problem

In a race of Andalusian chicken, when mating occurred between a black-feathered cock (BB) and a white-feathered hen (WW), all the members of the resulted generation have blue feathers (BW). When the cocks of the first generation are mated with the hens of the same generation, the individuals of the second generation have black, blue and white feathers. **Explain this genetically.**

Solution



• From the previous, it is clear that :

Genotypes	Phenotypes
BB	Black
BW	Blue
WW	White

• From the previous, in case of lack of dominance :

- There are three different phenotypes for three different genotypes of individuals.
- The phenotype indicates the genotype, because each phenotype has only one genotype.
- The mendelian ratio 3 : 1 (in case of complete dominance) was modified into 1 : 2 : 1 (in case of lack of dominance) which doesn't obey Mendel's laws.

1 Test yourself

Answered

Choose the correct answer :

(1) The following figure shows the crossing of two *Antirrhinum* plants, study it, then answer :

1. The individuals that produce symmetrical gametes are

- (a) (1), (2) & (3). (b) (1), (3) & (4).
(c) (1), (2) & (4). (d) (2), (5) & (7).

2. When crossing plant no. (4) with plant no. (6), the percentage of plants with red flowers is

- (a) 25% (b) 50%
(c) 75% (d) 100%

3. When crossing plant no. (5) with plant no. (7), it gives plants with

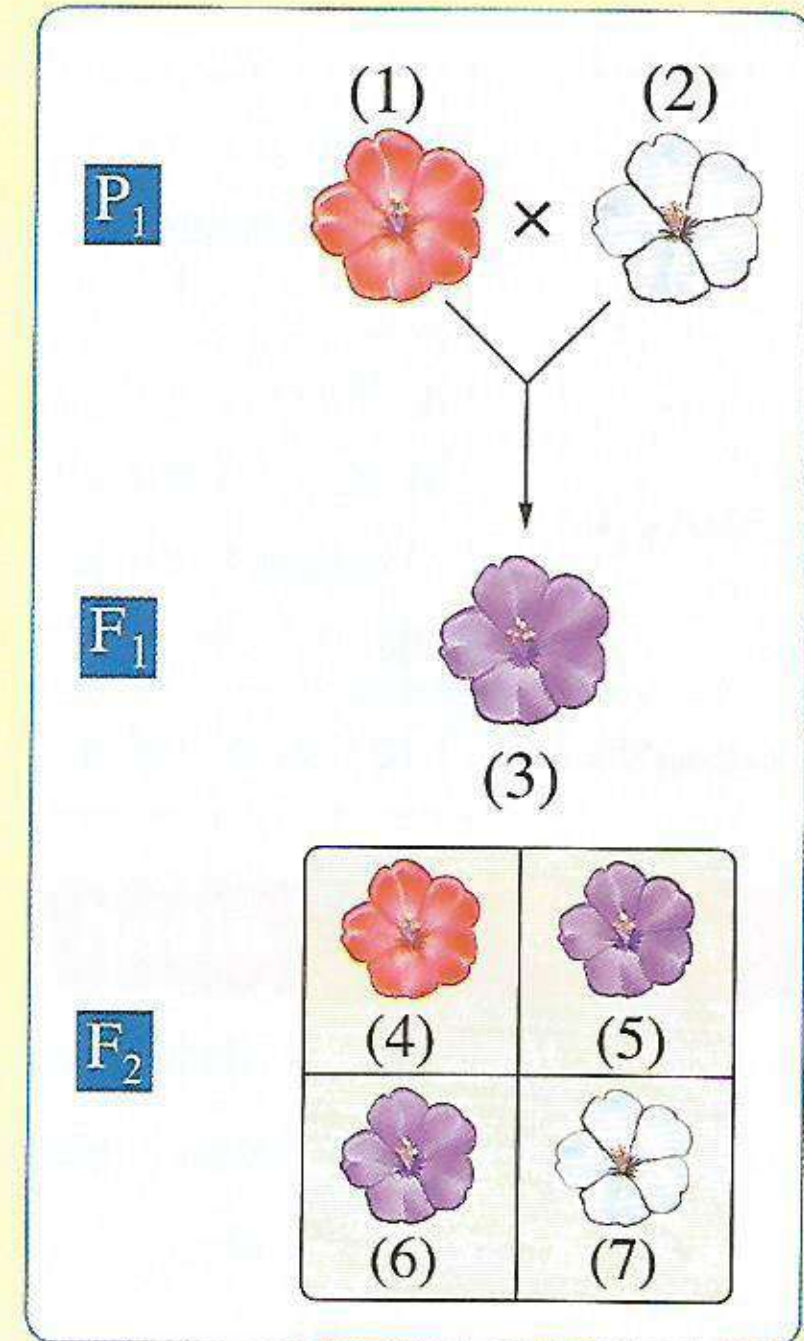
- (a) one genotype. (b) two genotypes.
(c) three genotypes. (d) four genotypes.

4. When crossing plant no. (3) with plant no. (6), it gives plants with

- (a) one phenotype. (b) two phenotypes.
(c) three phenotypes. (d) four phenotypes.

(2) When crossing a red-haired animal (RR) with a white-haired one (WW), all the resulted individuals were black-haired (RW), which of the following crossings gives 50% black-haired individuals only ?

- (a) Black with black. (b) Red with white. (c) White with white. (d) Red with red.



★ From the previous, we can compare between the complete dominance and the lack of dominance, as follows :

P.O.C.	Complete dominance	Lack of dominance
Dominance of one character :	Genes of one character (dominant character) dominate over the genes of the other character (recessive character).	Genes of one character don't dominate over the genes of the other character, but each of them shows its effect.
First generation individuals :	The dominant character appears in all members with a ratio 100%	The new character appears in all members with a ratio 100%

Second generation individuals :	<ul style="list-style-type: none"> They include two groups of individuals : <ul style="list-style-type: none"> - A group has the dominant character. - The other group has the recessive character. And this occurs with the ratio 3 : 1 respectively. 	<ul style="list-style-type: none"> They include three groups of individuals : <ul style="list-style-type: none"> - The 1st group has the character of one parent. - The 2nd group has the new character. - The 3rd group has the character of the other parent. And this occurs with the ratio 1 : 2 : 1 respectively.
Phenotype :	It doesn't indicate the genotype in case of the dominant character while indicating it in case of the recessive character.	It indicates the genotype, because each genotype has only one phenotype.
Example :	Flower's colour in pea plant.	Flower's colour in <i>Antirrhinum</i> plant.

B Inheritance of blood groups in human

- However, the blood components are constant in all humans, but they differ in the blood groups.
- Scientists could classify the blood groups into **four** groups which are : (A, B, AB and O).

For illustration only

The 14th day of June is considered the universal day of blood donation, and this day agrees with the birthday of the Australian scientist Karl Landsteiner who discovered the blood groups.



Karl Landsteiner

Blood groups classification

1 The genetic classification of blood groups

- Inheritance of blood groups is controlled by three types of genes called **alternatives (alleles)** which are (A), (B) & (O), as the individual inherits one pair only that is carried on the 9th pair of chromosomes in all humans.
- These alternatives form **six genotypes** which are (AA), (BB), (AB), (AO), (BO) and (OO).
- There are only **four phenotypes** for these six genotypes, which are : (A), (B), (AB) and (O), because the allele (O) is recessive with respect to each of the two alleles (A) and (B).
- The dominance is lacked between the two alleles (A) and (B) in the genotype (AB).
- Genotypes can be determined by following up the phenotypes of parents and offspring.

Blood group	Genotype
A	AA & AO
B	BB & BO
AB	AB
O	OO

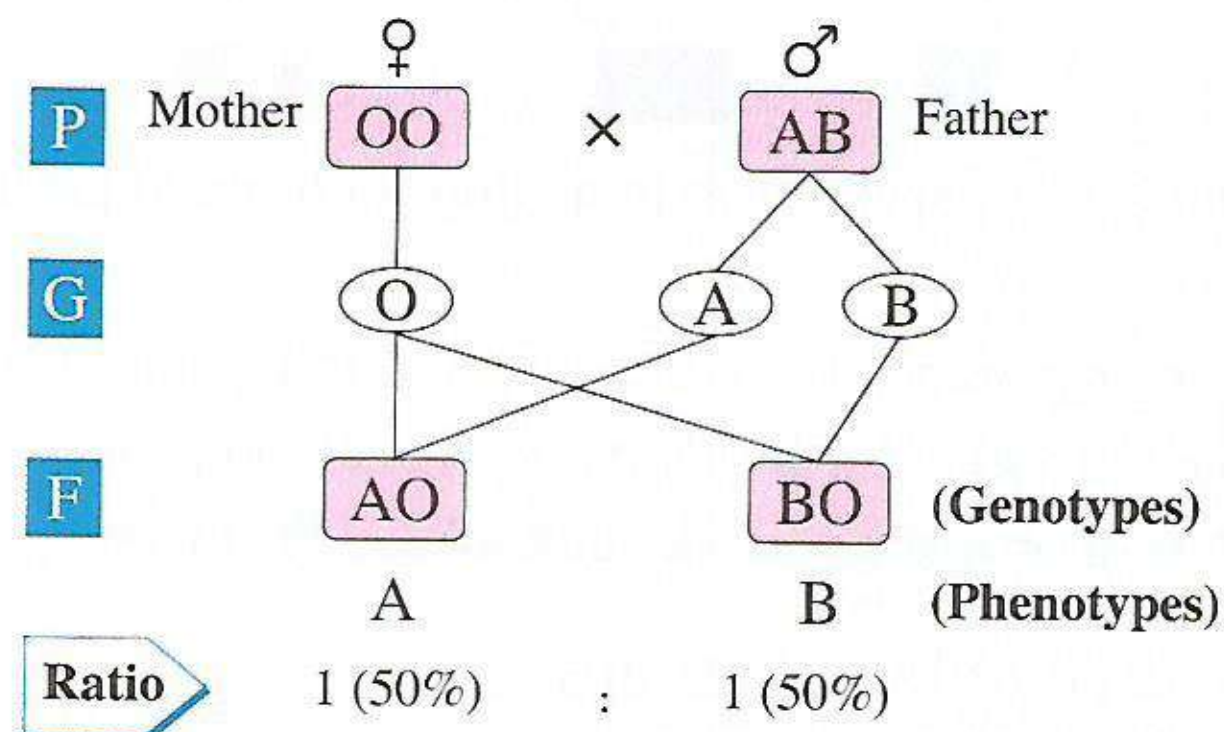
Conclusion :

- Inheritance of blood groups represents the cases of multiple alleles, complete dominance and lack of dominance, as follows :
 - **Multiple alleles** : there are three allelomorphic genes which are (A), (B) and (O) and the individual has only one pair of them.
 - **Complete dominance** : each of (A) and (B) genes dominates over the (O) gene.
 - **Lack of dominance** : each of (A) and (B) genes don't dominate over each other, but they participate together in the production of a new blood group which is (AB).

Problems

- ① A man with blood group (AB) married to a woman with blood group (O). What are the expected blood groups of their children ?

Solution



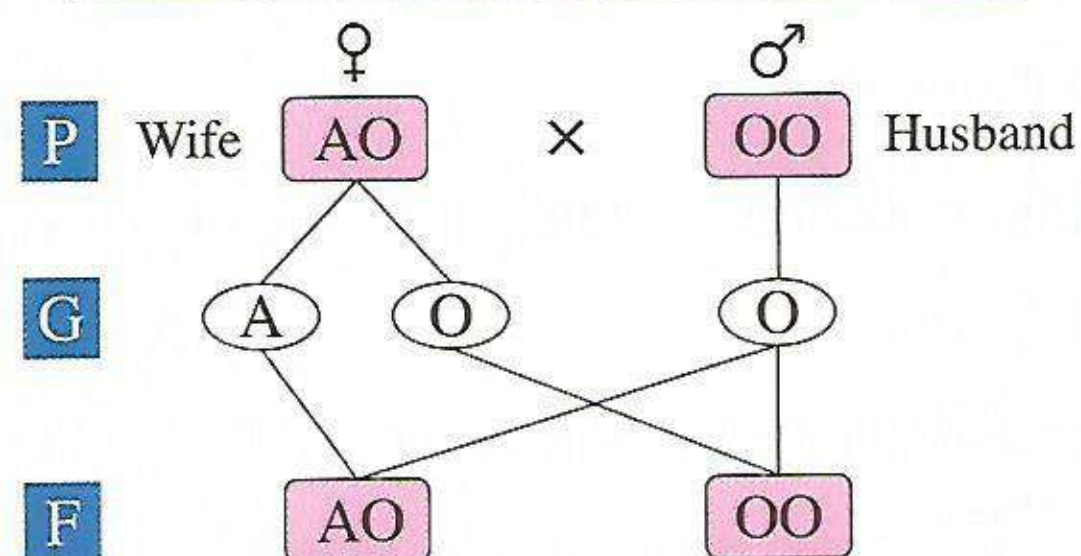
∴ The expected blood groups of their children are (A) and (B).

- ② A conflict occurred between two men about the eligibility of each one of them in the paternity of a child whose blood group is (O). The blood group of each man of them is (O), and the blood group of the first man's wife is (A), while that of the second man's wife is (AB).

Which man of them is the father of the baby ?

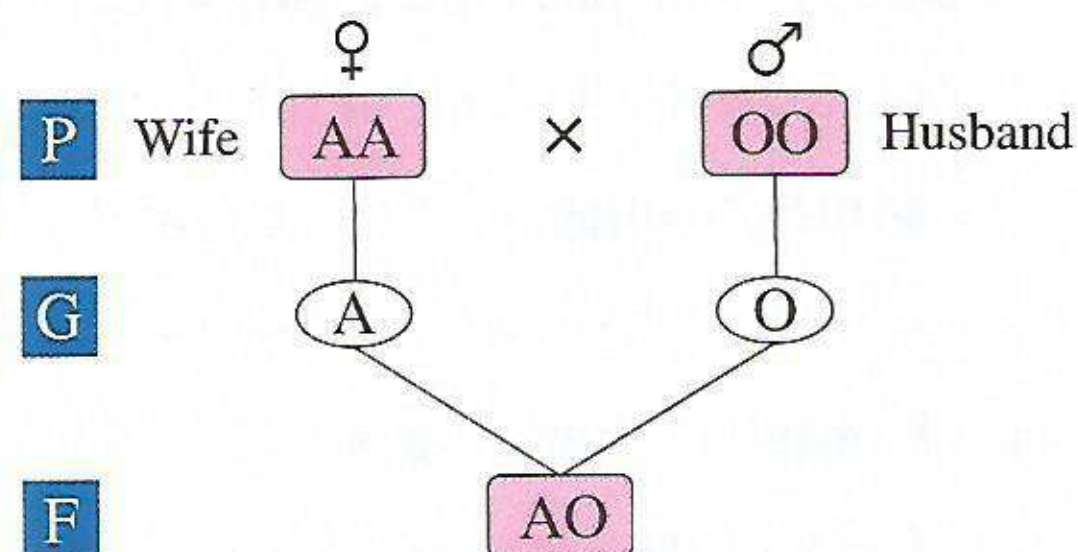
Solution

1st probability for the first man family



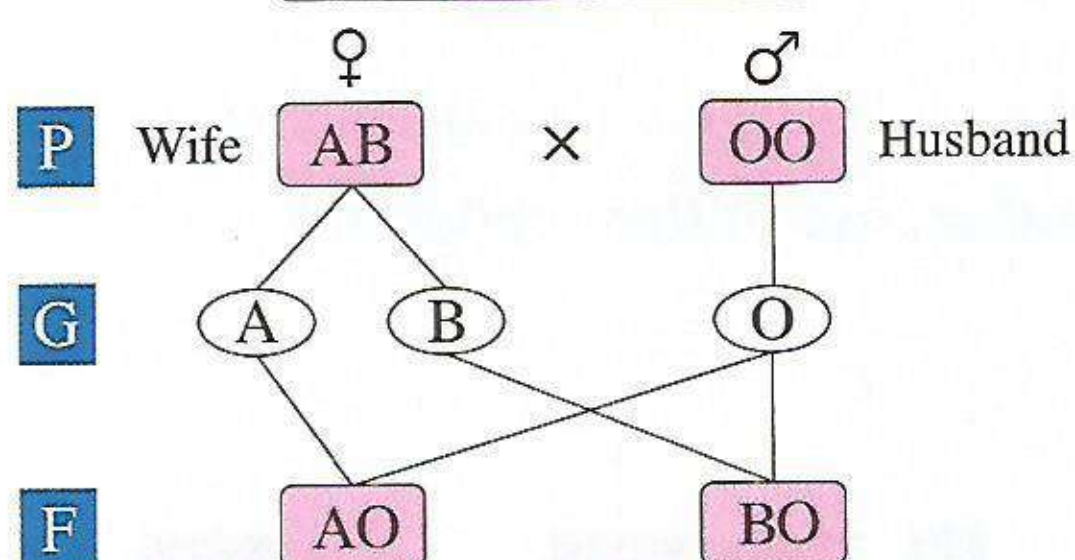
∴ The percentage of giving birth to a child with blood group (O) is 50%

2nd probability for the first man family



∴ The percentage of giving birth to a child with blood group (O) is zero.

Second man family



∴ The percentage of giving birth to a child with blood group (O) is zero.

• The explanation :

- The 1st man family can give birth to a baby with blood group (O).
- The 2nd man family can't give birth to a baby with blood group (O).

So, the baby with blood group (O) is the son of the first man.

2 Chemical classification of blood groups

- Blood groups are classified into four groups (A, B, AB & O), depending upon two types of chemical substances that are found in the blood, which are :

① Antigens

- Chemical substances found on the surface of red blood cells.
- They are two types which are :
 - Antigen (A).
 - Antigen (B).

② Antibodies

- Chemical substances that are antithetic to the antigens and found in the blood plasma.
- They are two types which are :
 - Anti-a.
 - Anti-b.

- The following table shows the chemical classification of blood groups :

Group	A	B	AB	O
Antigens	A	B	A & B	—
Antibodies	anti-b	anti-a	—	anti-a & anti-b

2 Test yourself

Answered

Choose the correct answer :

- (1) A man whose blood group doesn't contain antigens (A) and (B) married to a woman whose blood group doesn't contain antibodies (anti-a and anti-b). What is the probability for the presence of blood groups containing (anti-b) among children ?
- (a) 25% (b) 50% (c) 75% (d) 100%
- (2) A man whose blood group (pure) contains antigen (B) married to a woman whose blood group doesn't contain antigens (A) and (B). What is the probability for the presence of blood groups containing (anti-a) among children ?
- (a) 25% (b) 50% (c) 75% (d) 100%

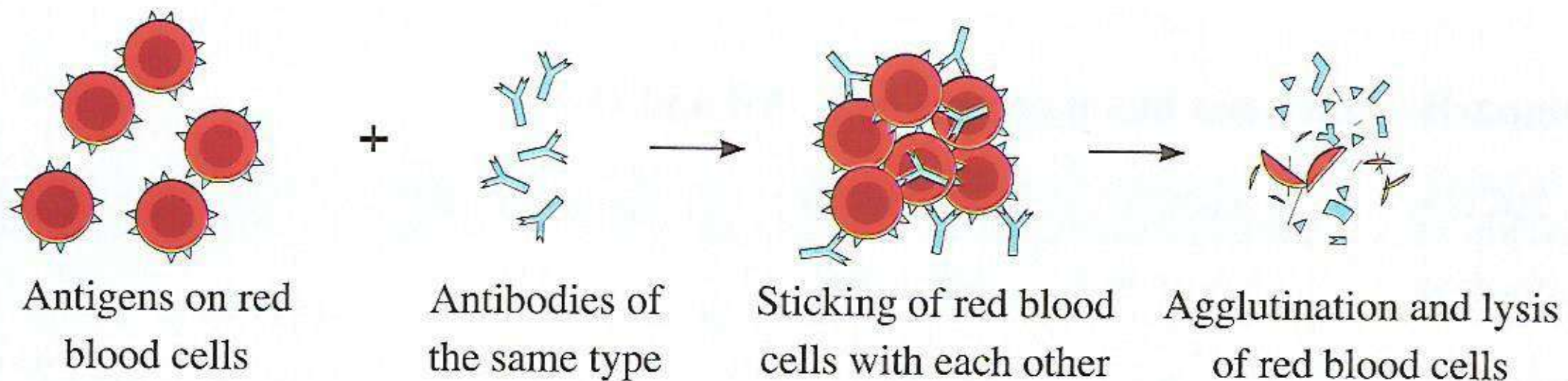
Determination of the type of blood group

- Each blood group has certain antigens and their corresponding antibodies that agglutinate with them.

For example :

- Antigens (A) agglutinate with antibodies **anti-a**.
- Antigens (B) agglutinate with antibodies **anti-b**.

- The type of the blood group can be determined through the reactions that occur between antigens and antibodies and the occurrence of an agglutination of blood or not.



Therefore, for determining the blood group, the presence of both types of antibodies (anti-a) and (anti-b) is needed.

1

A blood sample is withdrawn from the person who wants to determine his blood group. Then, two drops of blood are placed separately at the two ends of a clean glass slide.

Steps of determining the type of blood group

2

We put (anti-a) on the first blood drop and (anti-b) on the second blood drop.



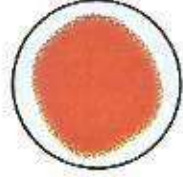





3

We mix each of them separately.



• The result :

We observe that the blood may be agglutinated (+) or not agglutinated (–), as shown in the following table :

1 st blood drop + (anti-a)	2 nd blood drop + (anti-b)	The possible blood group
Agglutination (+) 	No agglutination (–) 	A
No agglutination (–) 	Agglutination (+) 	B
Agglutination (+) 	Agglutination (+) 	AB
No agglutination (–) 	No agglutination (–) 	O

③ Test yourself

Answered

Choose the correct answer :

If we add a drop of blood with blood group (A) to a drop of blood sample with unknown blood group and it agglutinates, then we add another blood drop with blood group (B) to a drop from the same sample and no agglutination happens. So, the blood group of the unknown sample is

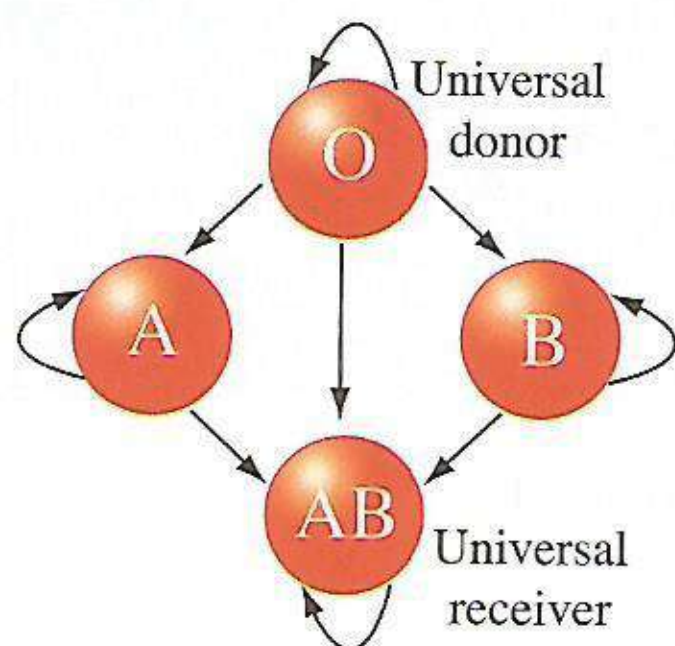
- (a) A (b) B (c) AB (d) O

★ Comparison between blood groups A, B, AB and O :

P.O.C.	Group (A)	Group (B)	Group (AB)	Group (O)
Genotype :	AA or AO	BB or BO	AB	OO
Antigens :	A	B	A & B	Doesn't contain antigens.
Antibodies :	anti-b	anti-a	Doesn't contain antibodies.	anti-a & anti-b
Donates blood to group :	A & AB	B & AB	AB	Donates blood to all groups (Universal donor).
Receives blood from group :	A & O	B & O	Receives blood from all groups (Universal receiver).	O
Determination :	Agglutinates by adding (anti-a).	Agglutinates by adding (anti-b).	Agglutinates by adding (anti-a) and (anti-b).	Doesn't agglutinate by adding (anti-a) or (anti-b).

Blood transfusion process

- Blood can be transfused among the different groups according to a special system, due to the presence of antigens and antibodies.
- The following table and figure show the system of blood transfusion between the different blood groups :



		The donor			
The receiver		A	B	AB	O
	A	✓	✗	✗	✓
	B	✗	✓	✗	✓
	AB	✓	✓	✓	✓
	O	✗	✗	✗	✓

Notes

- 1 The blood group (O) is called the universal donor, because it donates blood to all blood groups, due to the absence of antigens (A and B).
- 2 The blood group (AB) is called the universal receiver, because it receives blood from all blood groups, due to the absence of antibodies (anti-a and anti-b).

Life application:

• Risks of blood transfusion :

- 1 When transfusing a blood to a person that is incompatible with his blood group, some symptoms will appear, such as :
 - Shiver.
 - Headache.
 - Chest pains.
 - Breathlessness.
 - Blueness.
 - Tachycardia.
 - Hypotension.

These symptoms often end with death.

- 2 A viral infection can be transferred to the receiver, such as :

- Hepatitis C whose infection takes place through blood only, since it is not transferred among couples or from the mother to her fetus.
- Hepatitis B.
- AIDS.

- So, before the blood is transfused, a group of blood tests must be carried out on the donor's blood to make sure that :

- It is compatible with the receiver's blood group.
- It is free from pathogens, such as viruses.

Importance of blood groups

- ① Dispute resolution in determining the paternity and enrollment of children to their real parents (blood groups can be useful in denying the parentage, but it can't prove it) —→ **Judicial importance.**
- ② Determining the processes of blood transfusion among individuals, where they depend on the type of blood group and Rhesus factor (Rh) —→ **Medical importance.**
- ③ Used in the studies of human race taxonomy and studying the evolution —→ **Scientific importance.**

4 Test yourself

Explain : blood groups deny paternity, but don't prove it.

Answered

Rhesus factor (Rh)

- Rhesus factor is a type of antigens that is found on the surface of red blood cells in most humans (beside the antigens of the blood groups).

Enrichment information

Rhesus factor antigens were first discovered in 1940 in a race of monkeys called Rhesus monkeys. So, these antigens were given the name "Rhesus factor".

- Humans are classified according to the presence of Rhesus factor in their blood into :

Positive Rhesus factor (Rh⁺) individuals

- ▶ Their blood contains Rhesus factor antigens.
- ▶ They represent about **85%** of human beings.

Negative Rhesus factor (Rh⁻) individuals

- ▶ Their blood is free from Rhesus factor antigens.
- ▶ They represent about **15%** of human beings.

Inheritance of Rhesus factor

- The inheritance of Rhesus factor antigens is controlled by three pairs of genes that are carried on one pair of chromosomes, where the individual inherits all of them. So, the inheritance of Rhesus factor is not considered as multiple alleles.
- **The individual becomes :**
 - **Positive Rhesus factor (Rh⁺) :** when one or more of the three pairs of genes in the **dominant state** is present, it leads to the formation of Rhesus factor antigens.
 - **Negative Rhesus factor (Rh⁻) :** when all the types of genes are present in a **recessive form**.

Importance of Rhesus factor

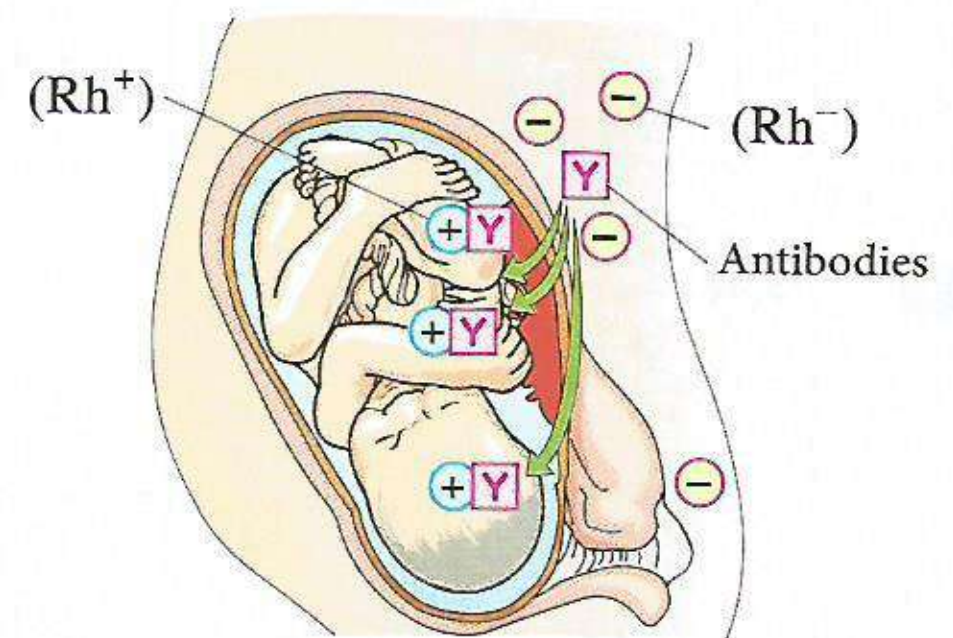
- Determination of Rhesus factor should not be neglected before blood transfusion processes and before marriage, to avoid the risks arising from the formation of antibodies against the antigens of Rhesus factor that cause the disintegration of red blood cells.

Role of Rhesus factor in pregnancy and delivery

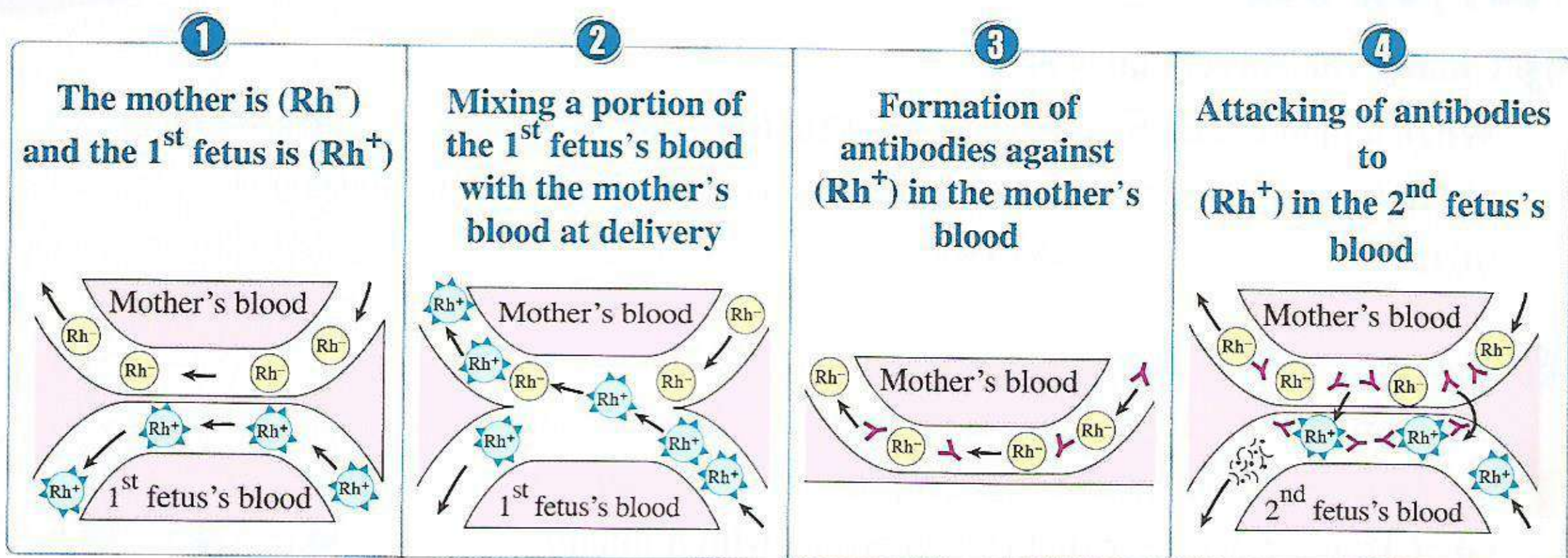


- If a (Rh^+) man is married to a (Rh^-) woman and she becomes pregnant with a (Rh^+) fetus, the following takes place :

- 1 In the 1st pregnancy, a portion of fetus blood (Rh^+) mixes with his mother's blood at delivery. This stimulates her immune system to produce antibodies against the antigens of Rhesus factor which don't harm this embryo, but these antibodies remain in the mother's blood.
- 2 In the 2nd pregnancy, if the fetus is (Rh^+) some of the antibodies that were formed during the first pregnancy move from the mother's blood to the blood of the fetus through the placenta. These antibodies cause the disintegration of the fetus's red blood cells and infect him with severe anaemia that may lead to his death.



Transferring of antibodies from the mother's blood to the blood of the second fetus through placenta



The risk of dissimilarity of Rhesus factor between the fetus and his mother

- The preventive measure in case of discovering this case before the delivery of the 1st baby :

Injecting the mother with a protective serum within 72 hours after each birth.

To protect the future baby, where this serum disintegrates the blood containing (Rh^+) that was mixed with the mother's blood from the previous fetus, before enhancing the mother's immune system to form antibodies.

★ The following table illustrates the effect of Rhesus factor of parents on offsprings :

Father	Mother	Offsprings	Conclusion
① (Rh ⁺) "Pure"	(Rh ⁺) "Pure"	No harm on offspring.	(Rh) of parents is symmetric. So, there is no danger on offspring.
② (Rh ⁻)	(Rh ⁻)	No harm on offspring.	(Rh) of parents is symmetric. So, there is no danger on offspring.
③ (Rh ⁻)	(Rh ⁺)	No harm on offspring.	(Rh) of parents is asymmetric and there is no danger on offspring, as (Rh) of the mother is positive (Rh ⁺).
④ (Rh ⁺)	(Rh ⁻)	If the first fetus is (Rh ⁺), this fetus doesn't subject to harm, but the mother must be injected with a protective serum within 72 hours after each birth to protect the future baby.	There is a danger on the second fetus, if the 2 nd fetus's (Rh) is positive and the first fetus's (Rh) was positive.

⑤ Test yourself

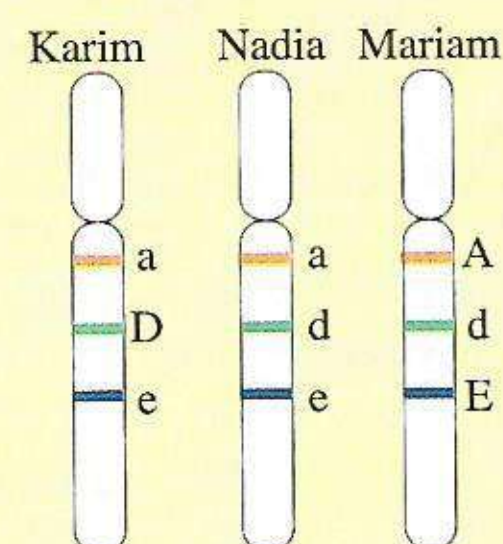
Answered

① Choose the correct answer :

When a man whose blood group is (ORh⁺Rh⁻) married to a woman whose blood group is (AB⁻), the probability of having a child with blood group (O⁻) is

- (a) 0% (b) 25% (c) 50% (d) 100%

② The opposite figure shows the sequencing of (Rh) genes on a part of homologous chromosome that belongs to three people (Karim, Nadia and Mariam), if a blood sample is taken from each one of them for analysis, **which one of them does his/her RBCs' surface have no (Rh) antigens ?** **With explanation.**



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Genes Interaction (Lack of Dominance)



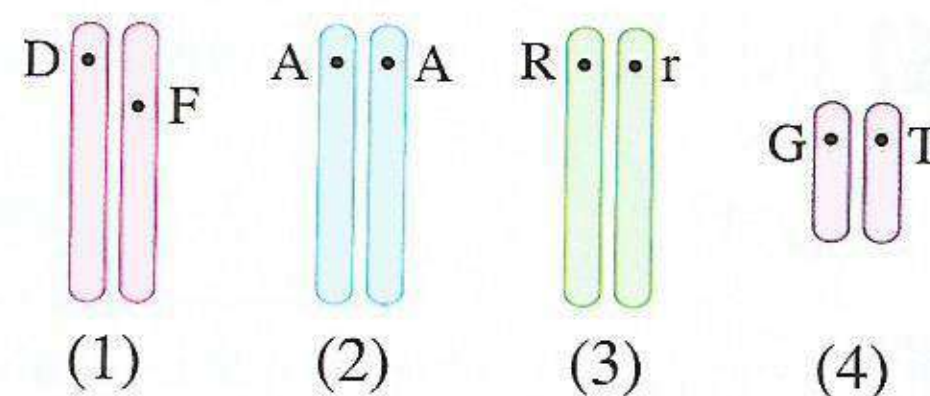
Interactive test

The questions signed by measure the high levels of thinking.

First

Multiple Choice Questions

- 1 In the opposite figure, which pair of chromosomes represents the lack of dominance case ?



- (a) (1) and (2).
- (b) (3) and (4).
- (c) (3) only.
- (d) (4) only.

- 2 When crossing two *Antirrhinum* plants, where one of them carried red flowers and the other carried white flowers, all the plants of the first generation were purple-flowered and the plants of the second generation carried red, purple and white flowers. So, this case is characterized by

- (a) the appearance of the two genes effect together.
- (b) the appearance of the effect of one gene.
- (c) the presence of a gene that can't complete its role alone.
- (d) the appearance of the parents' traits in the resulted generations happens rarely.

- 3 The inheritance of the flowers colour character in *Antirrhinum* plant is similar to that in pea plant, when crossing two pure individuals of different phenotypes in

- (a) carrying the first generation to the character of one of the parents.
- (b) the number of phenotypes.
- (c) representing the character by a pair of genes.
- (d) having one genotype for the recessive character.

- 4 When crossing two *Antirrhinum* plants, both of them carry purple flowers, answer the following :

- (1) The percentage of the resulted purple flowers from this crossing is

- (a) 100%
- (b) 75%
- (c) 50%
- (d) 25%

- (2) The percentage of the resulted white flowers from this crossing is

- (a) 100%
- (b) 75%
- (c) 50%
- (d) 25%

5 The genotype can be determined from the phenotype in all the following traits, except the

- (a) purple-coloured flowers trait in pea plant.
- (b) purple-coloured flowers trait in *Antirrhinum* plant.
- (c) green-coloured seeds trait in pea plant.
- (d) wrinkled-shaped seeds trait in pea plant.

6 The percentage of yellow-feathered birds resulted from crossing two red-feathered birds (RR) is

- (a) 75%
- (b) 50%
- (c) 25%
- (d) 0%

7 When crossing two radish plants, one of them with rectangular roots and the other with spherical roots, then the second generation plants are self-pollinated, the illustrated results in the opposite graph are obtained, study it, then answer :

(1) If you know that the gene of the rectangular-shaped roots is (L) and the gene of the spherical-shaped roots is (R). So, the expected genotypes for parents are

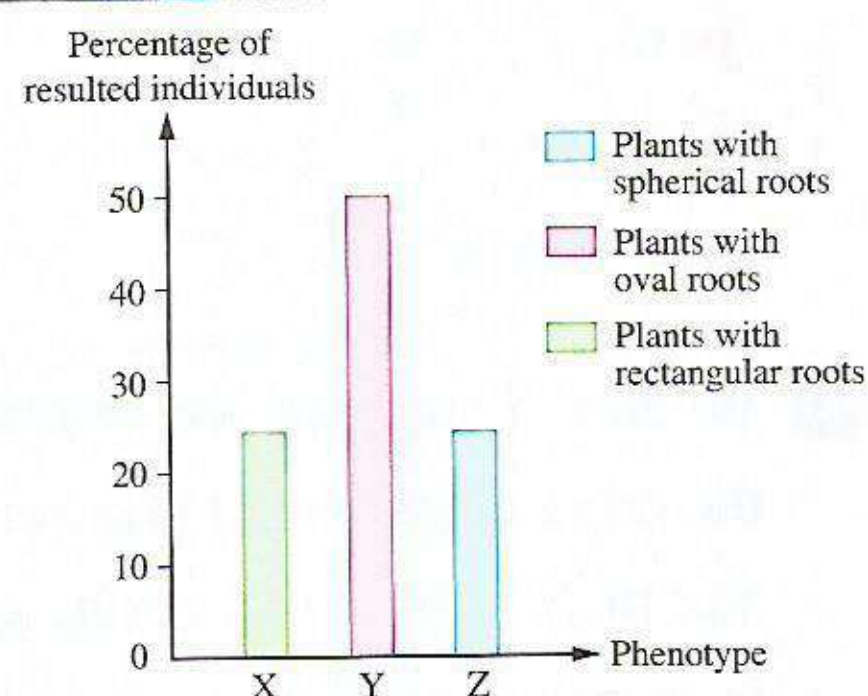
- (a) (RR) and (rr).
- (b) (LL) and (ll).
- (c) (RL) and (RL).
- (d) (RR) and (RL).

(2) The number of types of the genotypes of the radish plant with oval-shaped roots is

- (a) 1
- (b) 2
- (c) 3
- (d) 4

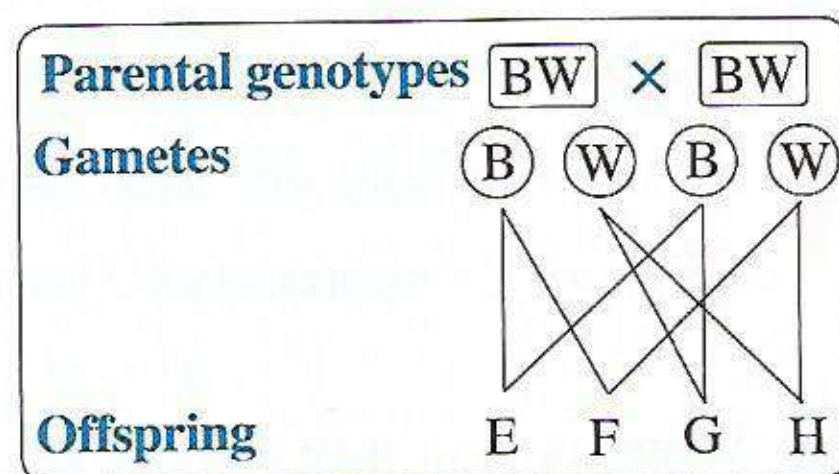
(3) When crossing two radish plants with spherical-shaped roots, the percentage of the resulted plants with oval-shaped roots is

- (a) 75%
- (b) 50%
- (c) 25%
- (d) 0%



8 The following diagram shows crossing between two heterozygous blue-feathered chickens. Which statement is not correct ?

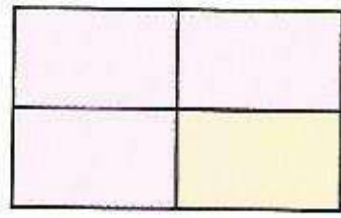
- (a) Offspring E and H are homozygous.
- (b) Offspring F and G are heterozygous.
- (c) The phenotypes of offspring E, F and G are the same.
- (d) The ratio of different phenotypes in the offspring is 1 : 2 : 1



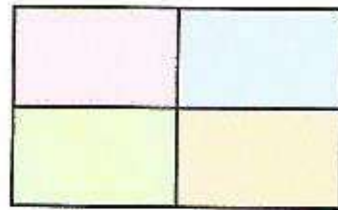
9 If you know that the character of brick-red colour is intermediate character between white and red colours, when crossing a brick-red coloured ox with a red cow, brick-red and red individuals are resulted with a ratio 1:1, what is the percentage of the appearance of red colour among the individuals of the resulted generation from the crossing of brick-red individuals ?

- (a) 25%
- (b) 50%
- (c) 75%
- (d) 100%

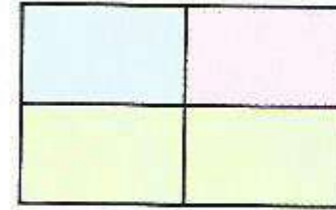
10 Which of the following figures represents the expected results in multiple alleles case ?



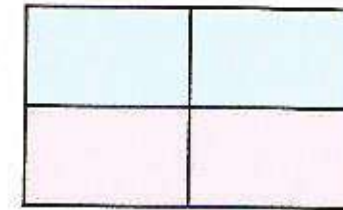
(a)



(b)



(c)



(d)

11 Blood group (AB) has one genotype, because [Choose two answers]

- (a) the gene (A) doesn't dominate over the gene (B).
- (b) the gene (A) dominates over the gene (O).
- (c) the gene (B) dominates over the gene (O).
- (d) the genes (A) and (B) participate together to appear this blood group.
- (e) the gene (O) represents the gene of the recessive character.

12 Which blood group contains (anti-a) only ?

- (a) (A).
- (b) (B).
- (c) (AB).
- (d) (O).

13 A man with blood group (A) married to a woman with blood group (B), they gave birth to a child with blood group (O), what are the genotypes of the parents blood groups ?

- (a) AA × BB
- (b) AO × BB
- (c) AA × BO
- (d) AO × BO

14 A mother whose blood group is (AB) has a son with the same blood group, what is the excluded blood group of the father ?

- (a) A
- (b) B
- (c) AB
- (d) O

15 If a drop of blood group (B) is added to a drop of unknown blood group sample, it agglutinates, then adding a drop of blood group (A) to another drop of the same unknown sample and the agglutination doesn't take place. So, the blood group of the unknown sample is

- (a) A
- (b) B
- (c) AB
- (d) O

16 How many genotypes of the blood groups containing antigens (A) or (B) or containing antigens (A) and (B) together ?

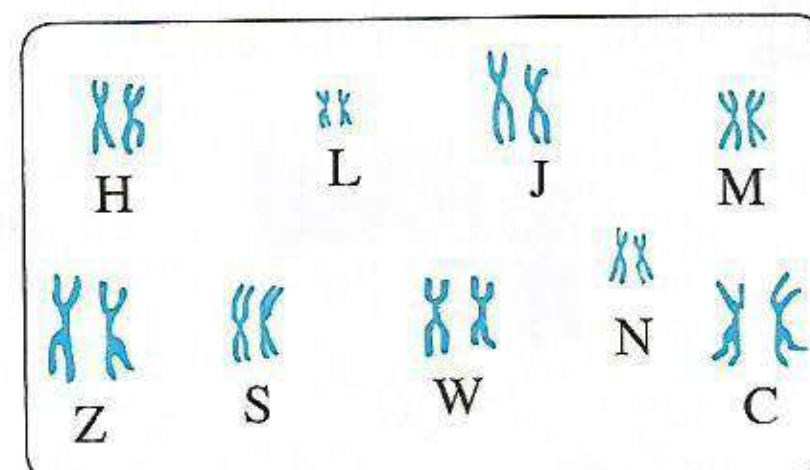
- (a) 3
- (b) 4
- (c) 5
- (d) 6

17 When a man with blood group (AB) married to a woman with blood group (O), what is the percentage of giving birth to children having the same blood groups of parents ?

- (a) 75% (AB) and 25% (O).
- (b) 50% (AB) and 50% (O).
- (c) 0% (AB) and 0% (O).
- (d) 25% (AB) and 75% (O).

- 18 The opposite figure shows the first nine pairs of chromosomes in the human karyotype which are randomly distributed, which pair of these chromosomes carries the blood group genes ?

(a) H (b) L
(c) J (d) S



- 19 From the properties of blood group (B) is that

(a) it can be transfused to any other blood group.
(b) it receives blood from all blood groups.
(c) it doesn't contain antibodies.
(d) it may be pure or hybrid.

- 20 The inheritance of blood group (O) is similar to the inheritance of the flower's colour character in the

(a) white flowers of *Antirrhinum* plant. (b) purple flowers of *Antirrhinum* plant.
(c) white flowers of pea plant. (d) purple flowers of pea plant.

- 21 If an agglutination occurs on adding a drop of (anti-a) to a glass slide containing a blood drop on it, the blood group of this person is

(a) (O) or (B). (b) (A) or (B). (c) (A) or (AB). (d) (B) or (AB).

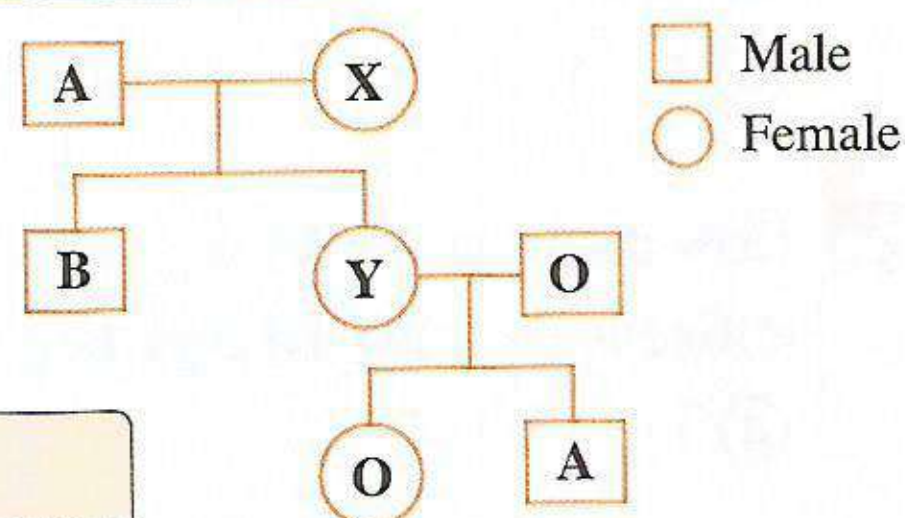
- 22 The percentage of children that carry blood group (AB) resulted from the marriage of a man whose blood group carries antigens (A) and (B) to a woman whose blood group doesn't carry antigens (A) and (B) is

(a) 25% (b) 50% (c) 75% (d) 0%

- 23 A man with blood group (AB) married to a woman with blood group (B) and her father's blood group is (O), the probability of giving children with blood group (B) is

(a) 25% (b) 50% (c) 75% (d) 0%

- 24 The opposite diagram illustrates the inheritance of blood groups in a family, study it, then answer :
Which choice in the following table can illustrate the genotypes of each of (X) and (Y) ?

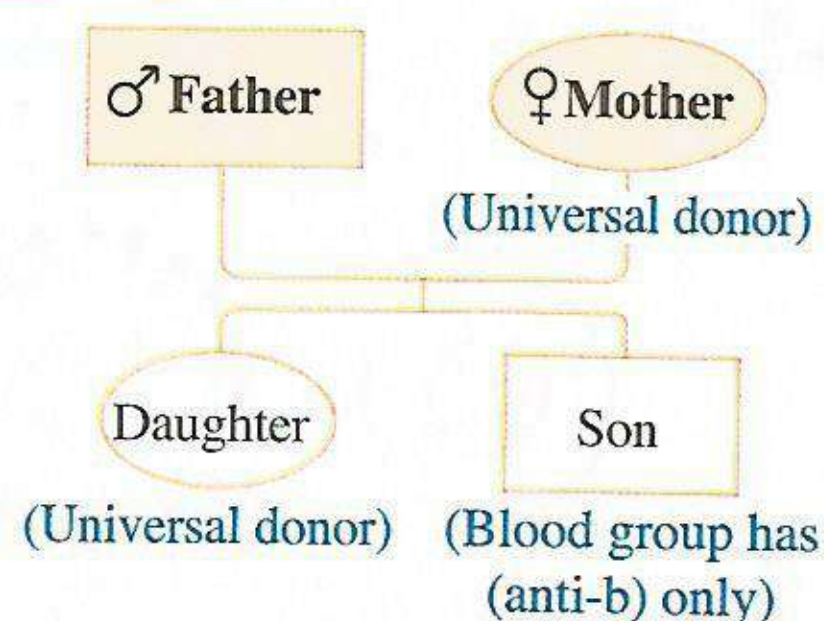


	(X)	(Y)
(a)	BB	AO
(b)	BB	OO
(c)	BO	BB
(d)	BO	AO

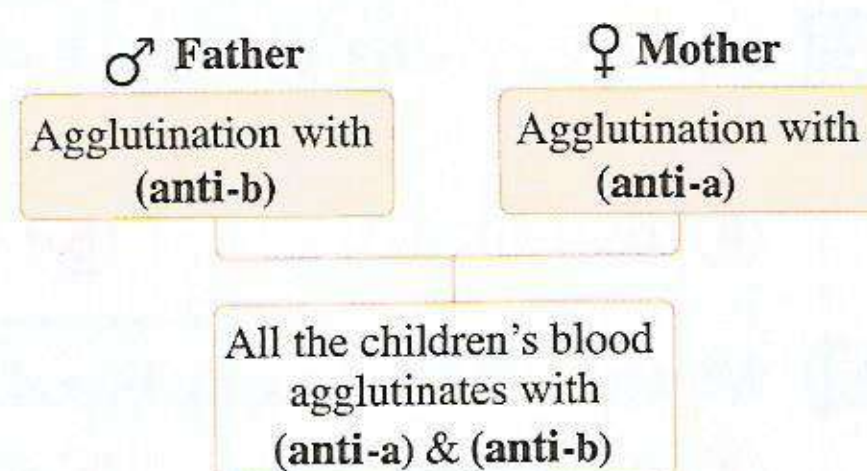
- 25 Four brothers have different blood groups from each other, this indicates that the genotypes of their parents' blood groups are
 (a) (BO) and (AB). (b) (AO) and (AB). (c) (OO) and (AB). (d) (AO) and (BO).
- 26 Which of the following blood groups have antigen (B) ?
 (a) (A) and (O). (b) (B) and (O). (c) (AB) and (B). (d) (AB) and (A).
- 27 If one of the parents has blood group (AB), he/she can't give birth to a child with blood group
 (a) (A). (b) (B). (c) (AB). (d) (O).
- 28 Blood group (A) is similar to the blood group (AB) in that both of them
 [Choose two answers]
 (a) contain antigens (A). (b) agglutinate when adding (anti-b).
 (c) have two genotypes. (d) agglutinate when adding (anti-a).
 (e) contain (anti-b).
- 29 A man whose blood group is (A) married to a woman has the same blood group, what is the genotype that wouldn't appear in the offspring ?
 (a) AO (b) AA (c) BO (d) OO
- 30 Which of the following crossings gives individuals whose blood groups carry antibodies (anti-a) ?
 (a) Father with a universal donor blood group and a mother has a pure blood group containing (anti-b).
 (b) Father with a universal receiver blood group and a mother has a pure blood group containing antigen (A).
 (c) Father with a universal receiver blood group and a mother has a pure blood group containing (anti-b).
 (d) Father with a universal donor blood group and a mother has blood group containing antigens (A) and (B).

- 31 The opposite diagram how blood groups are inherited in a family, what is the expected genotype of the father's blood group ?

- (a) AO (b) AB
 (c) BO (d) OO



- 32 The opposite diagram shows blood samples for father, mother and their children. So, the genotypes of the blood groups of the mother and father are



[Choose two answers]

- 33 The excluded genotype for the blood group of a man married to a woman with blood group (AB) and they gave birth to a child with blood group (A) is

- 34 If the blood group of the parents of a father is (O), it is impossible for the grandchildren to have a child with blood group

- 35 The genotypes of the blood groups that can be proven to a father with blood group (AB) and a mother with blood group (O) are

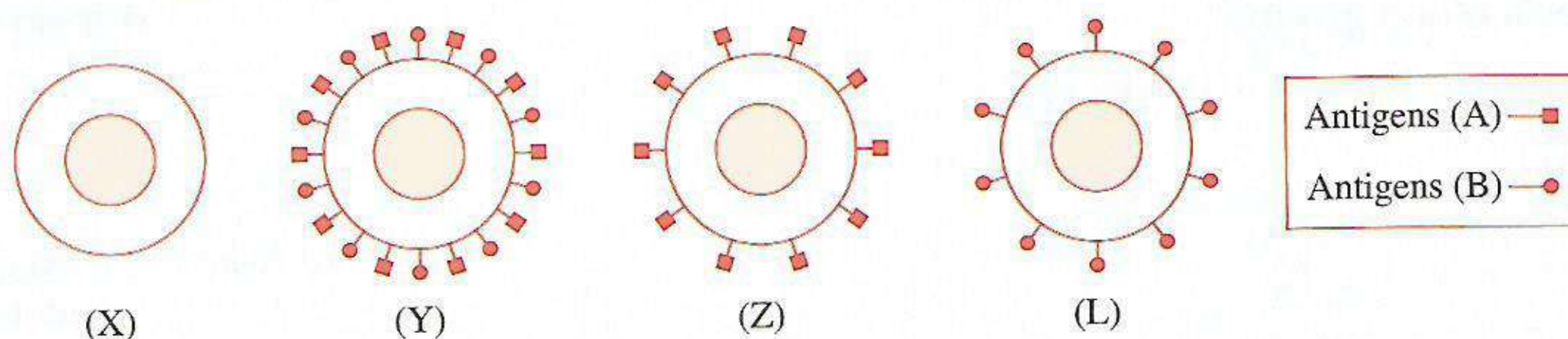
[Choose two answers]

- 36 The person whose red blood cells contain three types of antigens which specialized for determining the blood group, his/her blood group is

- 37 The number of individuals having negative Rhesus factor among 300 individuals of human beings is about

- 38 The person who can donate blood to all blood groups, his blood group has the genotype

- 39 The following figures represent red blood cells for the types of blood groups in human, study them, then answer :



(1) Which choice in the following table represents the blood group of each of cell (Y) and cell (L) ?

	(Y)	(L)
(a)	A	B
(b)	B	O
(c)	AB	B
(d)	A	AB

(2) The blood group of cell (X) is similar to the blood group of cell (L) in

- (a) some antibodies.
- (b) the type of antigens.
- (c) the number of genotypes.
- (d) the occurrence of agglutination on adding (anti-b).

(3) The blood group of cell (Y) is similar to the blood group of cell (Z) in


- (a) the number of antibodies.
- (b) the number of antigens.
- (c) the number of genotypes.
- (d) the reaction occurred with (anti-a).

40 The number of antigens that determines the blood group (O^+) is

- (a) 0
- (b) 1
- (c) 2
- (d) 3

41  The number of antigens that determines the blood group (B^+) is

- (a) 0
- (b) 1
- (c) 2
- (d) 3


42  If the mother is ($Rh^- Rh^-$) and the father is ($Rh^+ Rh^-$), and the mother wasn't injected with a protective serum after the delivery of a baby with (Rh^-). So, the probability of the death of the 2nd baby is

- (a) 0%
- (b) 25%
- (c) 50%
- (d) 75%

43 Antigens are found on the surface of the red blood cells of a person with blood group (A^-).

- (a) (A)
- (b) (B)
- (c) (A) and Rh^+
- (d) (B) and Rh^+

Second Miscellaneous Questions

1  In a strain of ornamental sparrows, there was a mating between two orange-feathered sparrows and the resulted generation from the mating was as follows :

- 86 red-feathered birds.
- 161 orange-feathered birds.
- 93 yellow-feathered birds.

(a) What is the genetic pattern controlling the inheritance of this trait ? Explain your answer.

(b) Give reason for : the appearance of individuals with new colours that differ from the parents.

2 "When crossing two pure individuals that differ in a pair of genetic traits, the ratio of the second generation is always 3 : 1". **How far this statement is correct ? Giving two examples.**

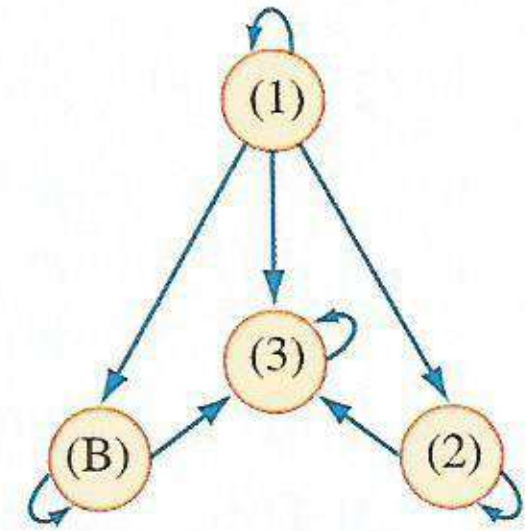
3 **What happens if :** blood is transfused from a person whose blood group is (AB) to a person whose blood group is (A) ?

4 **Explain :** the person whose blood group is (O) faces a great difficulty when needing a blood transfusion.

5 **The opposite figure represents the types of the blood groups :**

(a) Write the number and symbol of the blood group that express the following statements :

1. It contains antigens (A) and (B).
2. It contains (anti-b).
3. It is called the universal donor.



(b) "If an accident occurred to a person, the blood group of his father is blood group no. (1) and the blood group of his mother is blood group no. (3)". **Which one of the parents can donate blood to the son ? And why ?**

6 **What is the difference between :** blood group (AB) and blood group (O) ?

7 If you know that the centrifuge separates the blood plasma. So, if you have three tubes of blood samples, the first tube labelled by "blood group (A)", the second is labelled by "blood group (B)" and the third found without a label. **How can you identify the type of the third blood group using the other known blood groups ?**

8 **Give reason for :** the person with blood group (AB) doesn't find a difficulty when he needs blood transfusion.

9 **Examine the opposite table which shows the results of blood groups detection, then answer the following questions :**

- (a) What is the group that contains both types of antigens ?
- (b) What is the group that donates blood to all other blood groups ?
- (c) "If your blood group is (A) and you need a blood transfusion", **what** are the suitable blood groups for you ? **And why ?**

Blood group	anti-a	anti-b
(1)		
(2)		
(3)		
(4)		

- 10 Two parents have the same blood group and they gave birth to two sons, each of them has a different blood group from the other and from the parents. If you know that it is possible genetically to transfuse blood from any son to anyone of the parents but not vice versa. **Write the genotypes for the parents and sons.**

- 11 **Give reason for :** blood can't be transfused from a person with blood group (A) to a person with blood group (B).

- 12 ✎ The following figure shows the reaction of an antiserum (anti-b) with blood groups that are symbolized by X_1 , X_2 , Y_1 and Y_2 , knowing that :

(-) represents no agglutination.

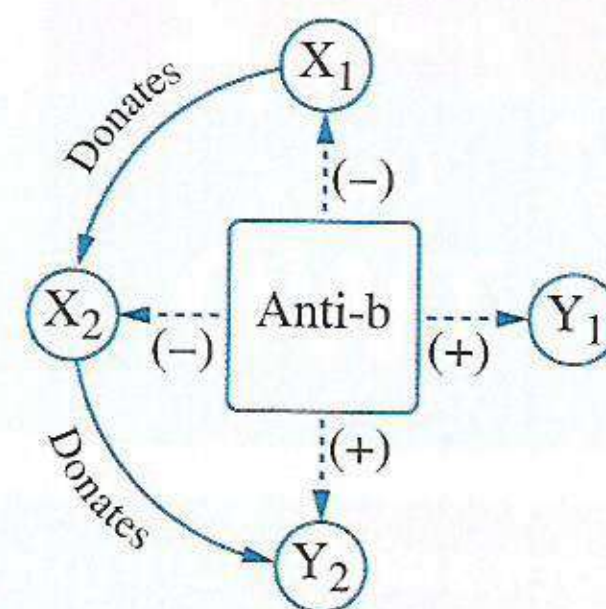
(+) represents agglutination.

(X_1) represents a universal donor.

(a) What is the genotype of (X_2) ?

(b) Write the name of blood group (Y_1).

(c) Determine the percentage of the probability of giving birth to children having blood group different from the parents, in case of the marriage of a woman with blood group (Y_2) to a man with a pure blood group (Y_1).

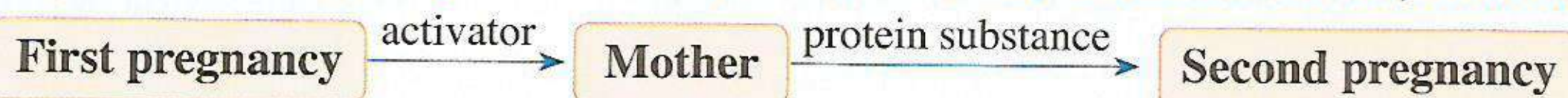


- 13 **Give reason for :** determining a blood group practically needs the presence of the two types of antibodies.

- 14 ✎ "A person with blood group (A) wants to donate blood to an injured person has the same blood group, and after carrying out the tests of blood compatibility for the two groups, the donor's blood was rejected, although he doesn't suffer from any diseases". **Discuss the possible reasons for rejecting the blood transfusion, despite the compatibility of the two groups.**

- 15 ✎ In the examination of two people's red blood cells whose blood groups are (B^-) and (AB^-), it was found that the RBCs' surface contains similar and different bodies. **Explain that.**

- 16 Study the following diagram in the light of your study to Rhesus factor, then answer :



If you know that the second baby may die from severe anemia and the mother didn't receive any transfused blood. **What is the phenotype of the mother's Rhesus factor ?**

- 17 **Give reason for :** the negative Rhesus factor person (Rh^-) doesn't receive blood, except from a negative Rhesus factor person (Rh^-) only.

- 18 ✎ **Give reason for :** the second baby for (Rh^-) mother married to (Rh^+) father may not die, despite the mother wasn't injected with a protective serum after the first birth.



CHAPTER 2

LESSON TWO

- **Continue : Genes Interaction (Complementary genes and Lethal genes).**
- **Effect of Environmental Conditions on the Action of Some Genes.**

Second Complementary genes

Complementary genes

They are the genes that work together to emerge a specific genetic trait, where the inheritance of this trait is controlled by two pairs of genes, and the emergence of the dominant character depends on the presence of a dominant gene at least in each pair, whereas the absence of any pair of the dominant genes or both will lead to the disappearance of the dominant character and the recessive allelomorphic character appears.

- **The ratio in :**
 - 1st generation (F_1) is 100% dominant.
 - 2nd generation (F_2) is 9 (dominant) : 7 (recessive).

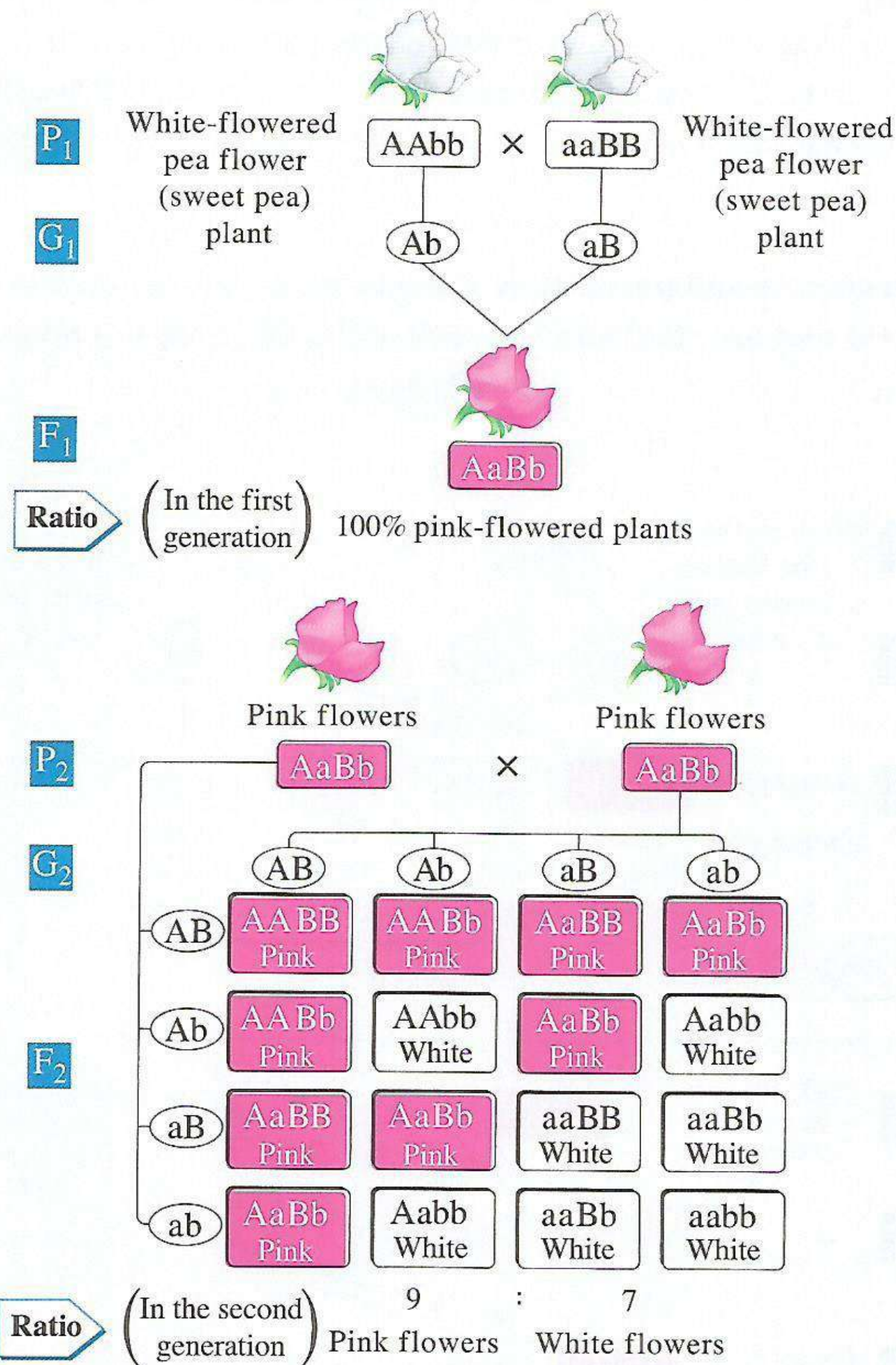
Example

- The inheritance of the flowers colour in pea flower (sweet pea) plant, where :
 - The pink colour of flowers represents the dominant character, while the white colour represents the recessive character.
 - The appearance of the flowers colour in this plant is controlled by two different pairs of dominant genes (A and B) and recessive genes (a and b). So, the possibilities of the genotype are as follows :

Pink colour genotype	AaBb				AaBB	AABb	AABB	
Gametes	AB	Ab	aB	ab	AB	aB	AB	Ab

White colour genotype	aabb	aaBb		Aabb	aaBB	AAbb	
Gametes	ab	aB	ab	Ab	ab	aB	Ab

- The genetic explanation for the crossing of a white-flowered pea flower (sweet pea) plant (AAbb) with another white-flowered plant (aaBB) :
 - The plants of F_1 have 100% pink flowers (AaBb), where they gather a dominant gene from each pair.
 - When F_1 plants were self-pollinated and their seeds were cultivated, the F_2 plants have pink and white flowers with a ratio 9 : 7 respectively.
- We can express this genetically, as follows :



Hint

In scientific references, it is mentioned that crossing a white-flowered pea flower plant (sweet pea) (AAbb) with another white-flowered one (aaBB) will produce a generation of purple-flowered plants not pink as mentioned in the text.

Explanation :

The appearance of the dominant character (pink colour) in the flowers of pea flower plants (sweet pea) requires the convergence of a dominant gene or more from both pairs, because both dominant genes participate in producing the dominant character, where each of them controls the production of a specific enzyme that affects the formation of the pigment of pink colour.

This indicates the complement action of genes, where in this case the dominant character can be obtained from two parents, each of them carries the recessive character.

It is noticed that, the ratio of the 2nd generation (F₂) in case of complementary genes (non-mendelian characters) is 9 : 7 (according to one pair of allelomorphic characters), whereas the ratio of the 2nd generation in case of the law of independent assortment of genes (mendelian characters) is 9 : 3 : 3 : 1 (two pairs of allelomorphic characters).

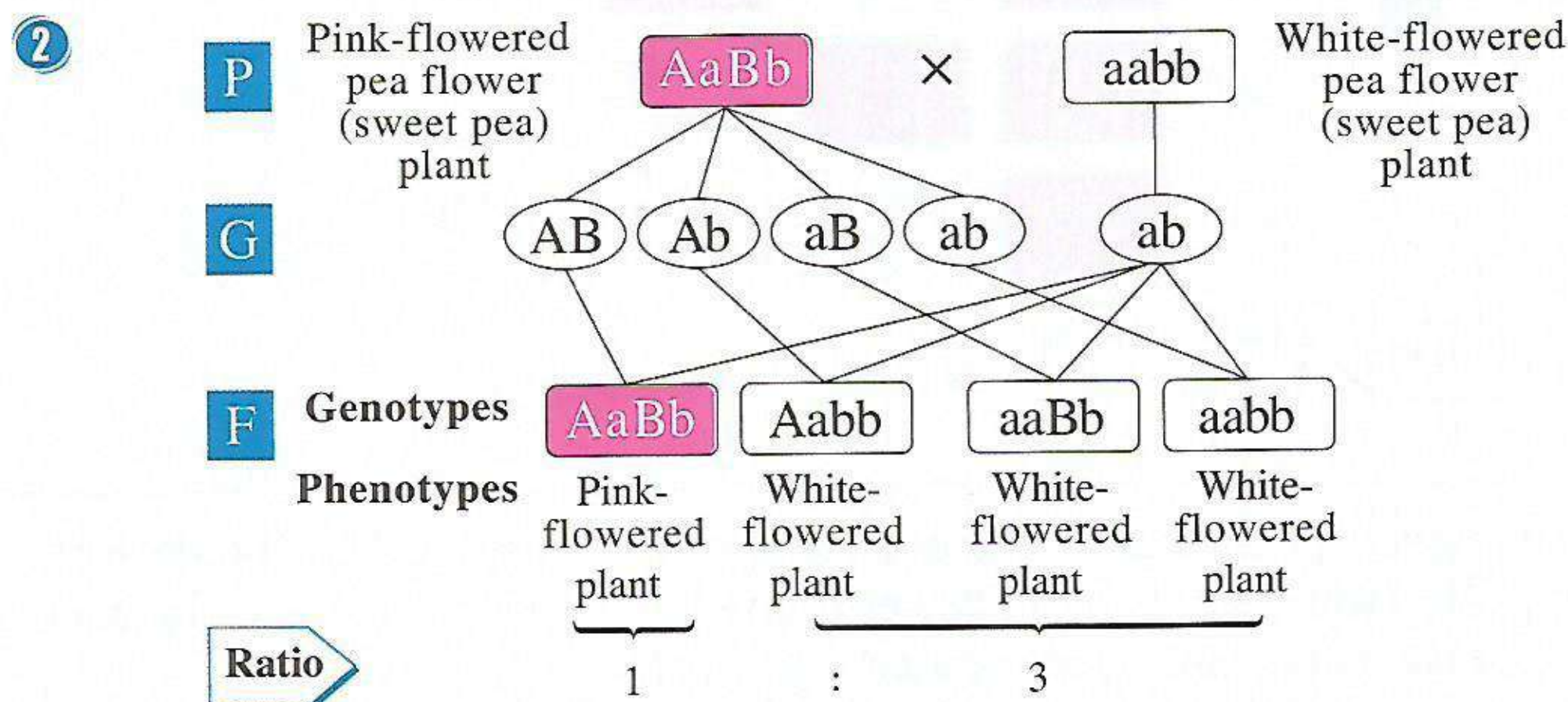
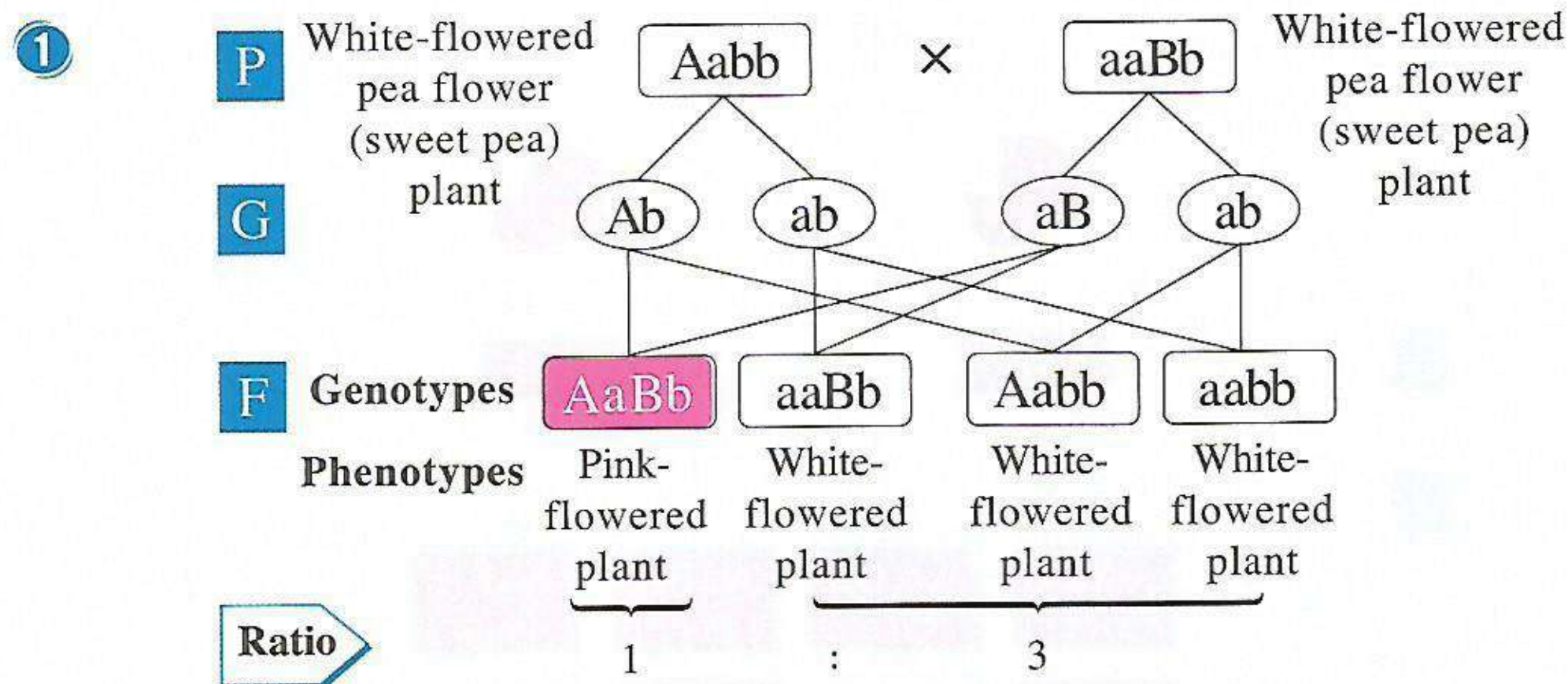
Problem

What are the genotypes and phenotypes of the flowers colour character in pea flower plants (sweet pea) that are resulted from each of the following crossings :

① Aabb × aaBb

② AaBb × aabb

Solution



1 Test yourself

Answered

The following figure shows the crossing of two white-flowered sweet pea plants, examine it, then choose the correct answer :

(1) The ratio for the appearance of the genotype of plant (S) in the resulted generation is

- (a) $\frac{9}{16}$ (b) $\frac{7}{16}$
(c) $\frac{1}{16}$ (d) $\frac{16}{16}$

(2) When a crossing occurs between plant (J) and plant (L), the percentage of white-flowered plants in the resulted generation is

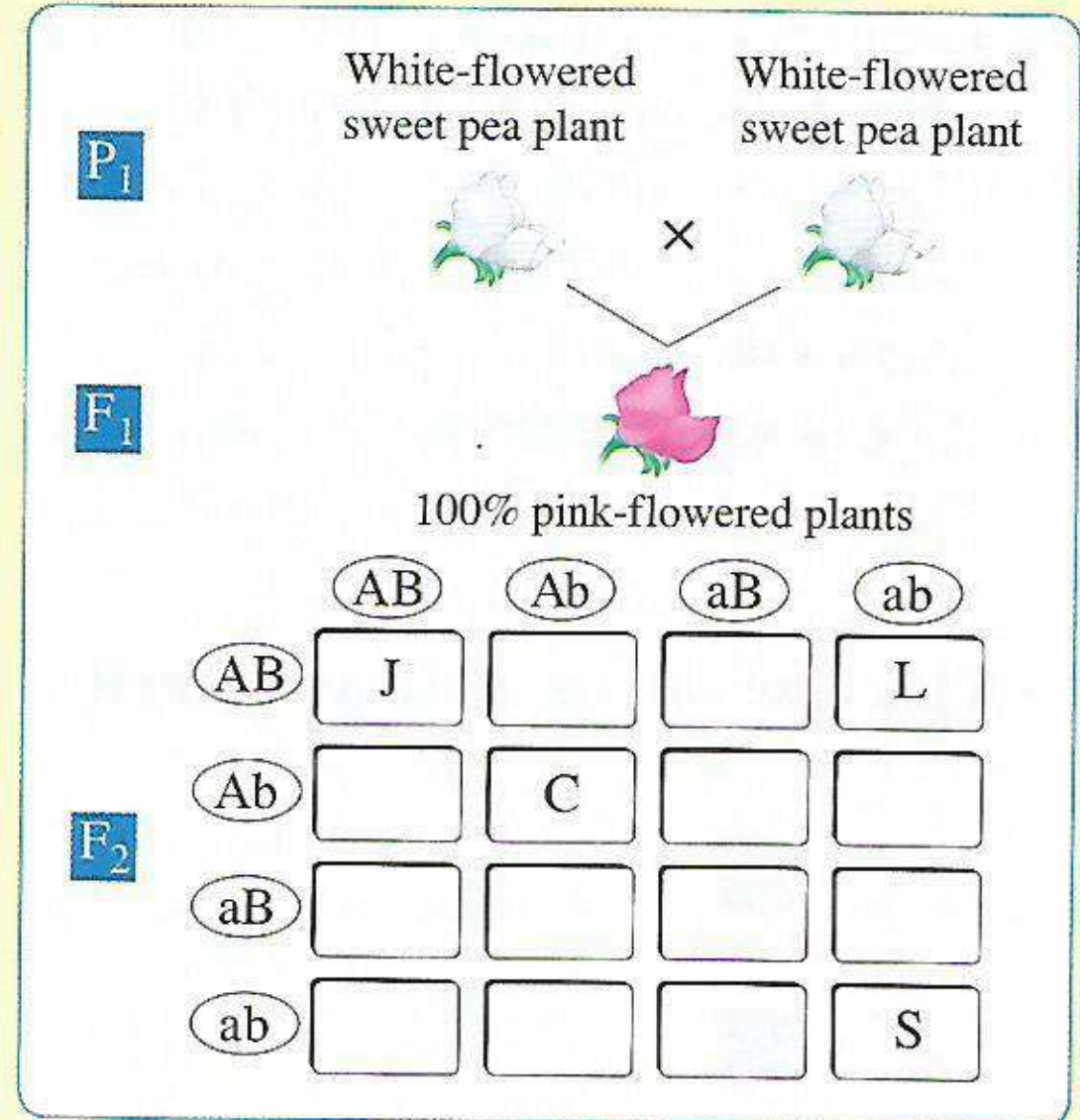
- (a) 0% (b) 25%
(c) 50% (d) 100%

(3) All the following give one type of gametes, except

- (a) C (b) S
(c) J (d) L

(4) The ratio of individuals that give four types of gametes is

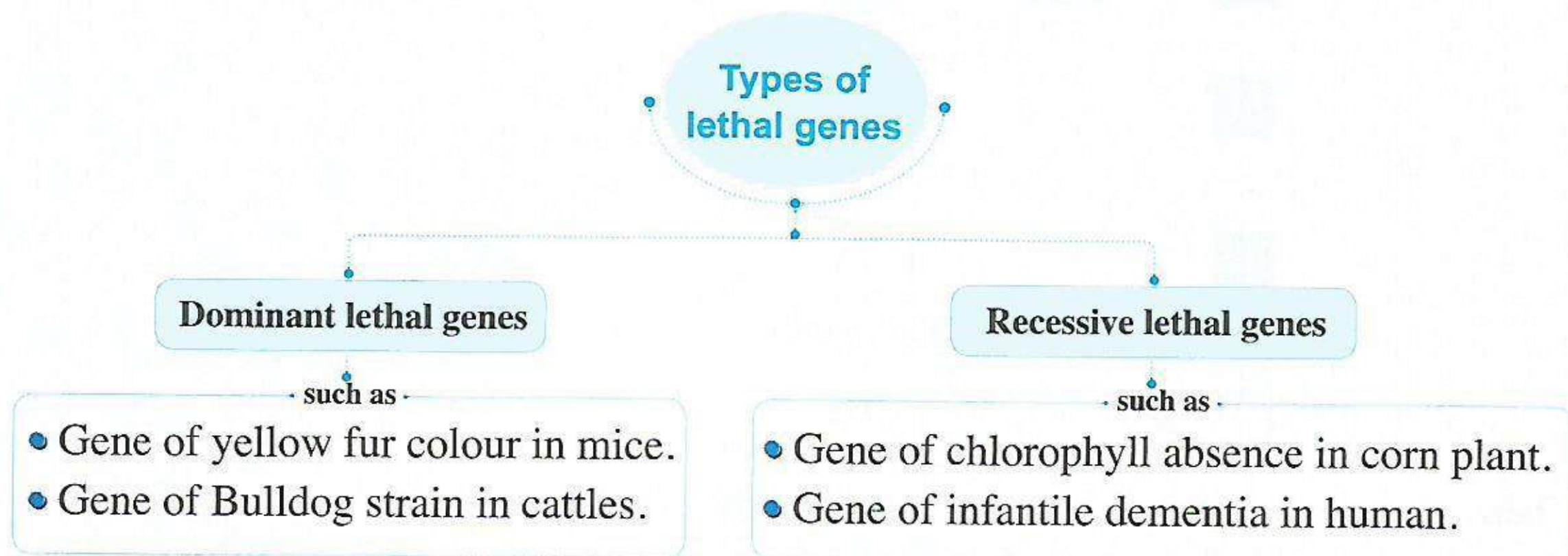
- (a) $\frac{4}{16}$ (b) $\frac{7}{16}$ (c) $\frac{9}{16}$ (d) $\frac{15}{16}$



Third Lethal genes

Lethal genes

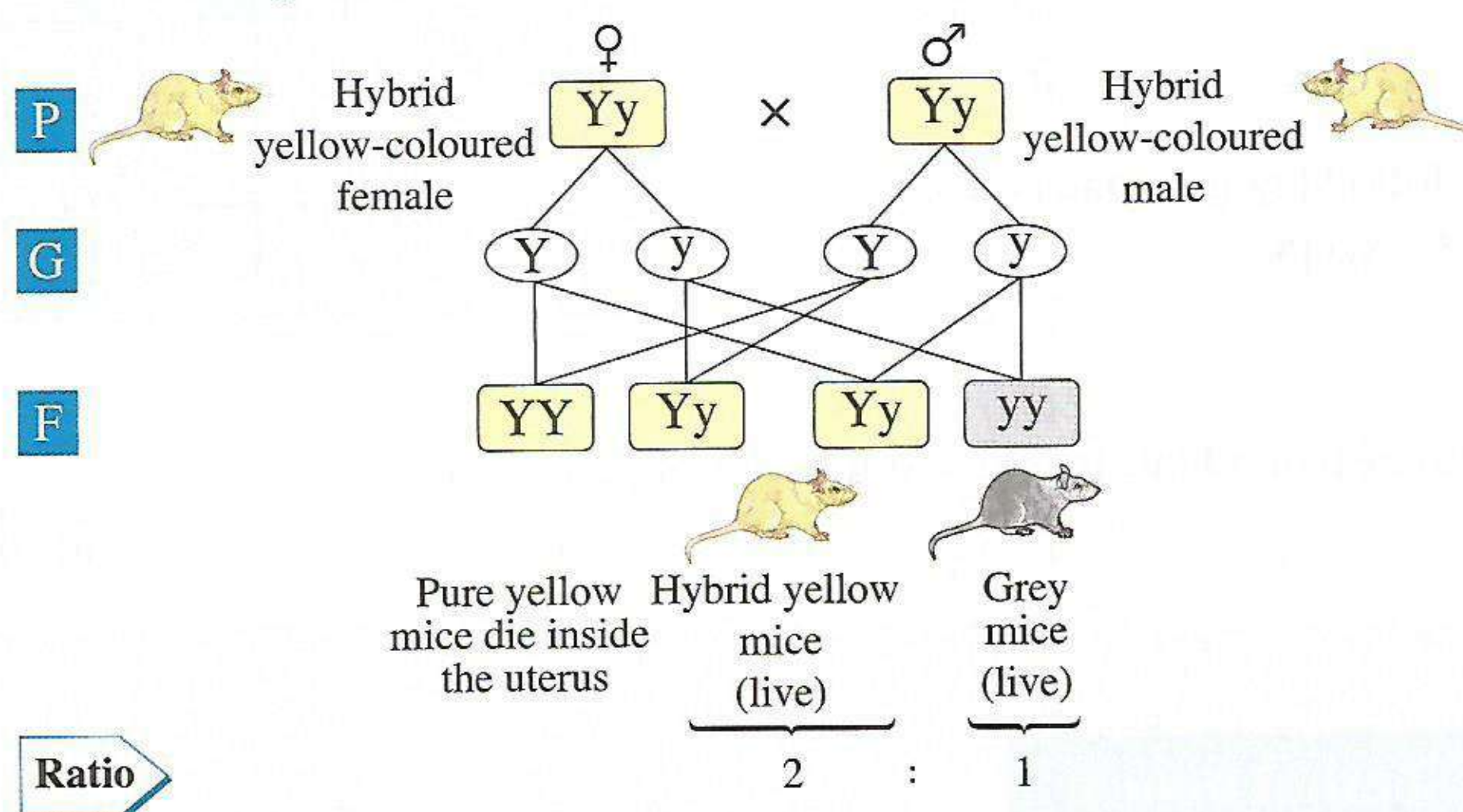
They are the inherited genes when found in a pure state (dominant or recessive), they cause harms to the living organism, resulting in the disruption of some vital processes and leading to the death of the living organism in different stages of life, representing (25%) of the offspring.



A Dominant lethal genes

Inheritance of yellow fur colour in mice

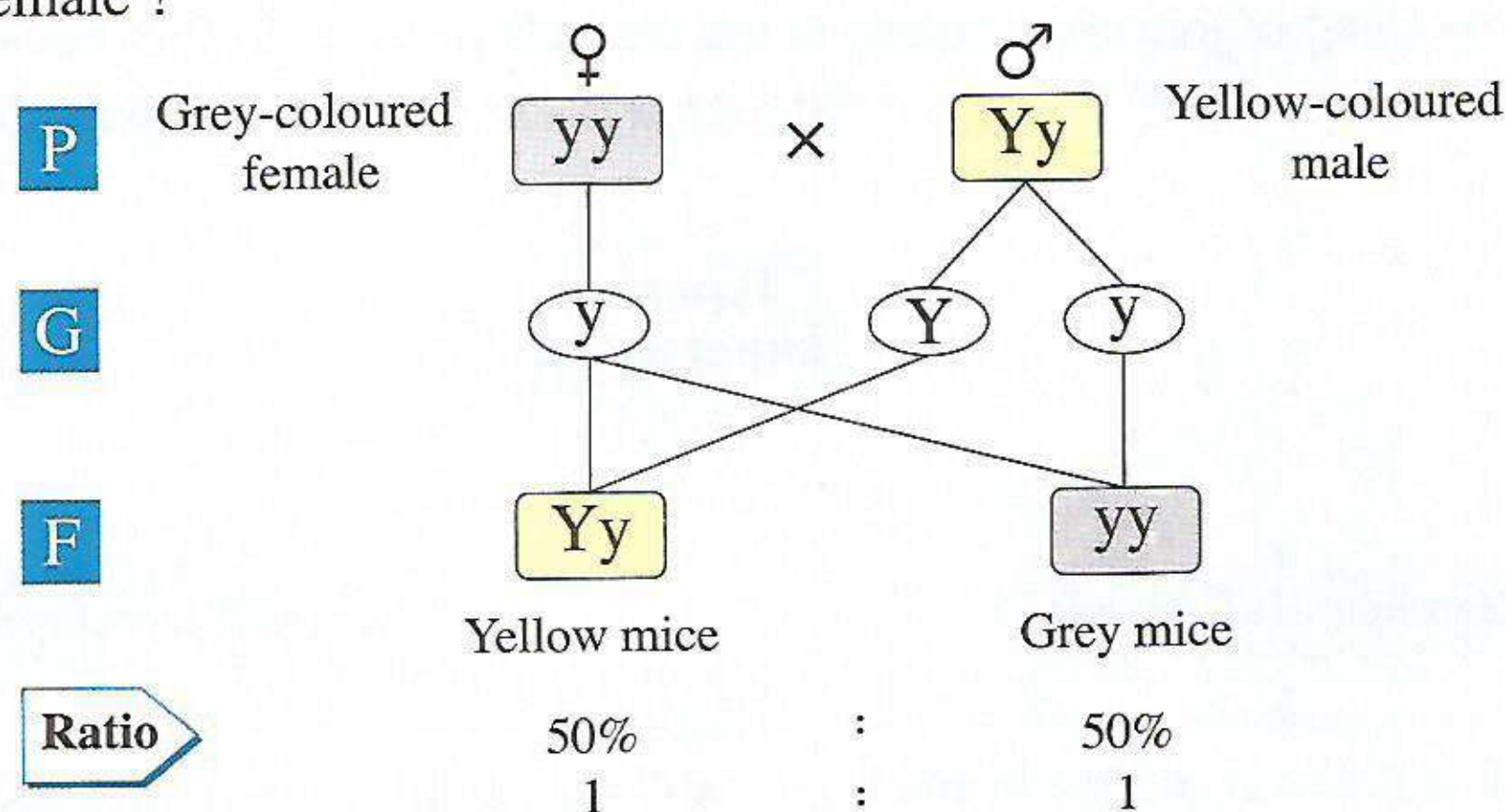
- The genetic explanation for the crossing of a male and female mice, each of them has a heterozygous yellow fur (Yy) :
 - The gene of yellow fur colour in mice (Y) dominates over the gene of grey fur colour (y).
 - The presence of a pair of pure (homozygous) dominant genes of yellow fur colour (YY) causes the death of yellow mice inside their mother's uterus.
 - The dead mice represent about $\frac{1}{4}$ of the resulted generation (25%).
 - The inheritance of this character takes place through heterozygous (hybrid) parents in their genotype (Yy).
- This case can be explained genetically, as follows :



Problem

What is the percentage of mice lost, when a yellow-coloured male is mated with a grey-coloured female ?

Solution

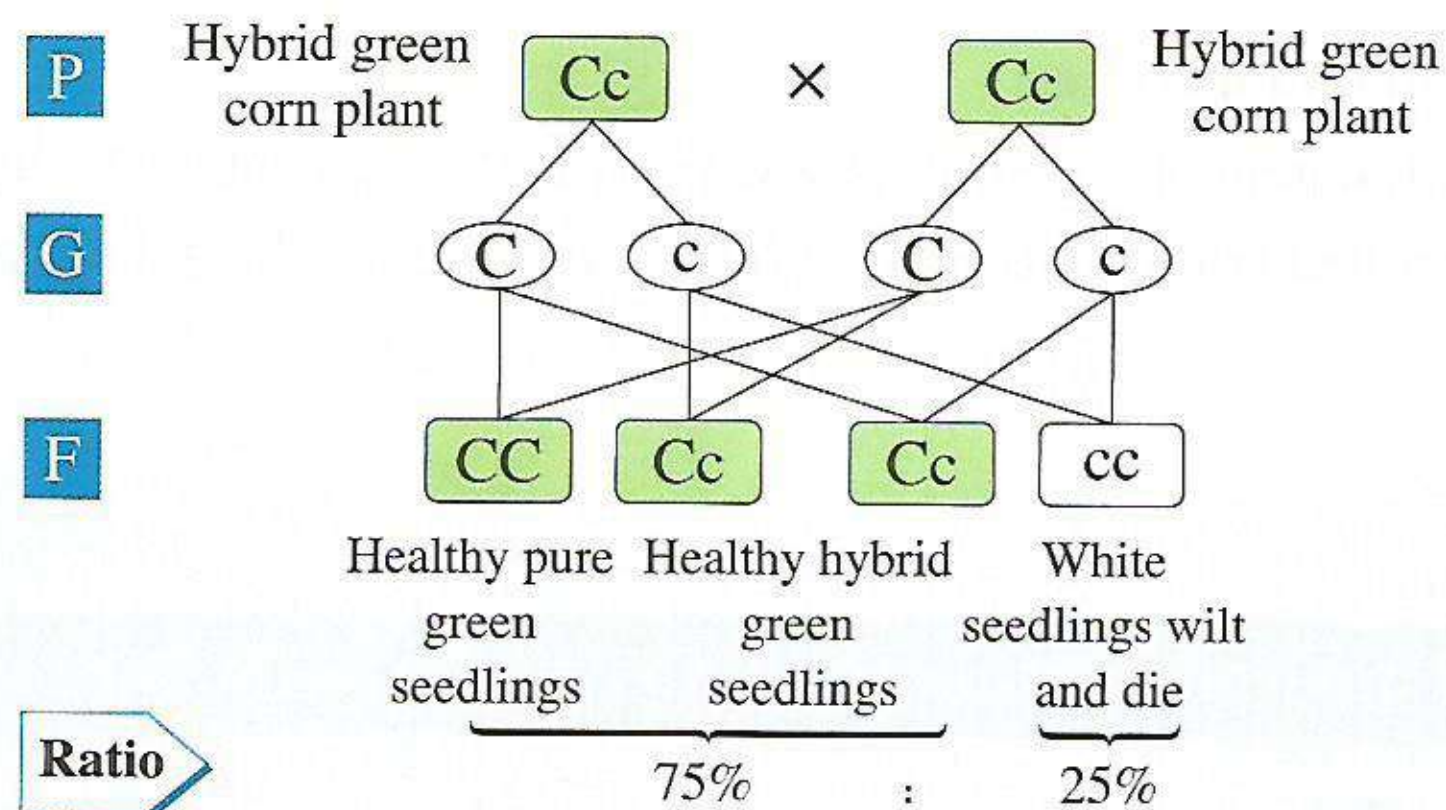


- There is no loss in mice, due to the absence of the converged pair of the pure dominant (homozygous) lethal genes together, (i.e. there are no pure yellow mice among the individuals of the resulted generation).

B Recessive lethal genes

Inheritance of chlorophyll absence character in corn plant

- When some corn plants were self-pollinated and their seeds were cultivated, it was noticed that some seedlings grew free from chlorophyll (white-coloured) that were shortly grown, then wilt and die, due to the presence of a recessive lethal gene in the pure form (cc). This gene is the chlorophyll absence gene.
- The gene of chlorophyll presence (C) in corn plants is dominant over the gene of chlorophyll absence (c).
- The convergence of a pair of recessive genes (in pure state) in some corn seedlings leads to the prevention of the formation of chlorophyll substance that acquires the plants their green colour and are responsible for absorbing the light energy needed for photosynthesis.
- The seedlings that wilt and die represent about $\frac{1}{4}$ of the resulted generation (25%).
- The inheritance of this character takes place through heterozygous (hybrid) parents in their genotypes (Cc).
- **This case can be explained genetically, as follows :**



- We can avoid the loss in corn plants and obtain seedlings with green colour by crossing two pure dominant plants together or two plants one of them is pure dominant and the other is hybrid.

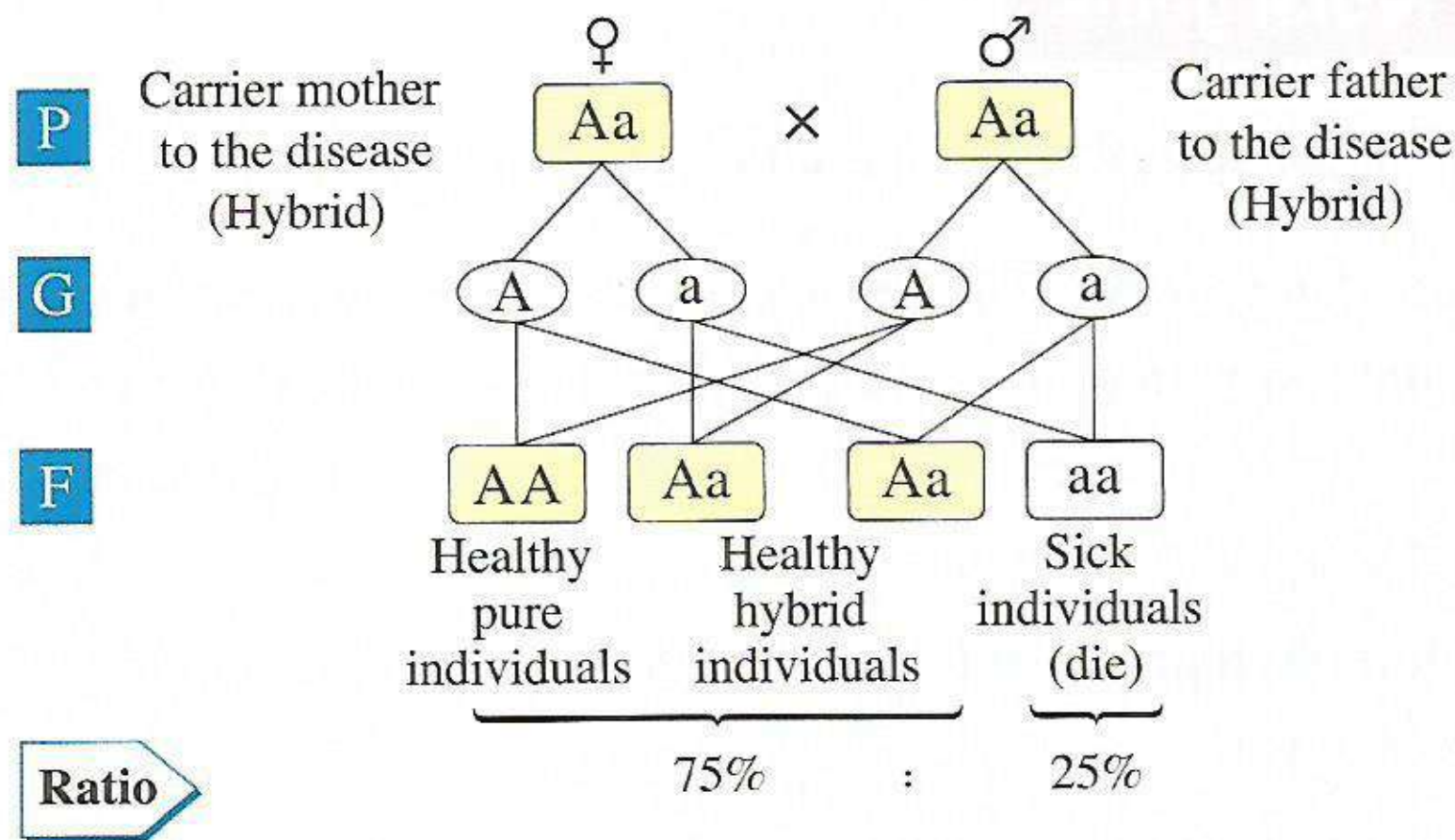
Problem

Some children suffer from an inherited disease known as **infantile dementia** which causes death, if its genes are recessive (aa).

What is the result of the marriage of a hybrid man and a hybrid woman in this trait ?

Illustrating the percentage of the individuals that may die.

Solution



2 Test yourself

Answered

- ① If you know that the gene of stellate (star) eyes character in *Drosophila* insect is lethal in its pure form. **What happens when crossing two stellated-eyed insects ? Explain your answer.**

.....

.....

.....

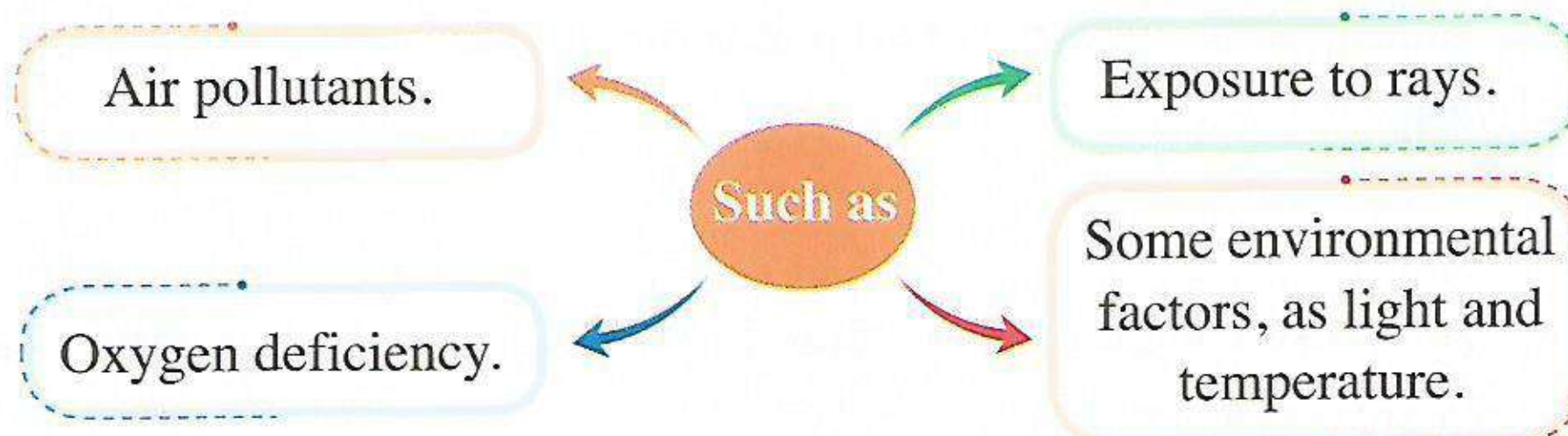
- ② **Choose the correct answer :**

A recessive lethal gene is found in cows. What is the percentage of the normal individuals resulted from crossing two hybrid individuals for this gene ?

- (a) 0% (b) 25% (c) 50% (d) 75%

Effect of environmental conditions on the action of some genes

- Modern researches have proven that the action of some genes is affected by the factors surrounding the living organism :



- Studying these factors helps in avoiding the risks that may arise from them.

Effect of light absence on the appearance of chlorophyll character in green plants

- When germinating a group of wheat or corn grains in an illuminated place with irrigating the seedlings regularly for several days, green seedlings grow, due to the presence of light factor which is needed by the gene that is responsible for the formation of chlorophyll pigment to show its effect.



Seedlings in light

- When germinating a similar group of wheat or corn grains in non-illuminated place (dark room) with irrigating the seedlings regularly for several days, yellow seedlings grow, then wilt and die after a period of time, due to the absence of light that is needed by the gene which is responsible for the formation of chlorophyll pigment to show its effect.



Seedlings in dark

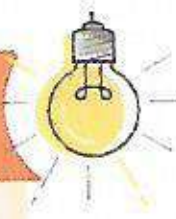
Notes

- The internal cabbage leaves are white-coloured, because they are not exposed to the light needed for appearing the effect of the gene that is responsible for the formation of green chlorophyll pigment, on contrast the external leaves are green-coloured, due to their continuous exposure to the light which helps in the formation of chlorophyll.
- When exposing the internal cabbage leaves to light, they are changed into green, due to the appearance of the effect of green chlorophyll gene.

For illustration only

- From the examples that ensure the effect of environmental conditions on the appearance of the inherited traits :*

- Himalayan rabbit fur is coloured with a black colour, if it is exposed to cold for a long period of time.
- The wings of *Drosophila* fly (after pupation) grow in a straight form after the exposure of eggs to a temperature of 16°C, and grow in a curved form after the exposure of eggs to a temperature of 25°C.





Practical Activity

Effect of light on chlorophyll appearance in green plants

Used materials and tools :

- Agricultural soil.
- Wheat or corn grains.
- Plastic or pottery container.
- Water.

Procedures	Figures	Observations
<ol style="list-style-type: none"> 1 Germinate a group of wheat or corn grains in an illuminated place and irrigate the seedlings regularly for several days. 2 Germinate a similar group in a dark room and irrigate the seedlings regularly for several days. 	<p>The effect of light on the colour of wheat plant seedlings :</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>Figure ① Seedlings in light</p> </div> <div style="text-align: center;">  <p>Figure ② Seedlings in dark</p> </div> </div>	<ol style="list-style-type: none"> 1 Green seedlings grow (figure ①). 2 Yellow seedlings grow, then wilt and die after a period of time (figure ②).

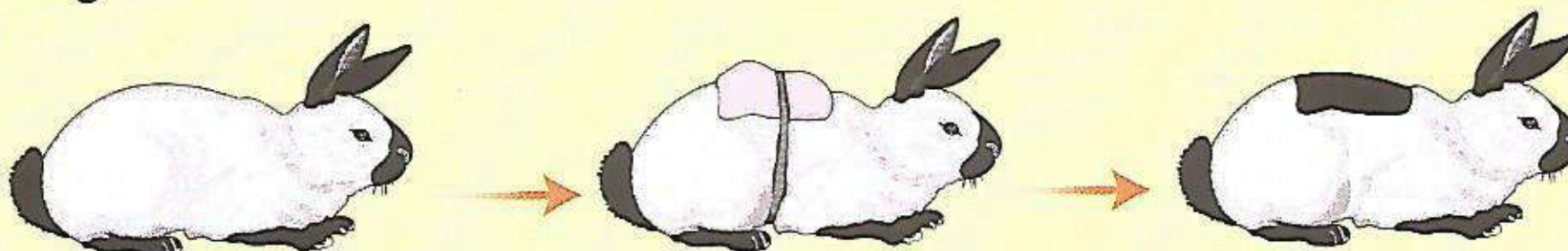
Conclusions :

- 1 The gene that is responsible for the chlorophyll formation in green plants needs the light factor to show its effect.
- 2 In the absence of the gene causing the appearance of chlorophyll, the plant can't form the chlorophyll pigment, even if it was placed in light.

③ Test yourself

Answered

The Himalayan rabbit strain is characterized by black limbs as legs, tail, as well as ears, mouth and nose area, while the rest body is white-coloured. When the white hair was shaved from the rabbit back and an ice-bag was tied over this area for a long period of time, the new grown hair under the ice-bag was black-coloured, unlike the rest of the surrounding hair that was remained white :



① **Determine** the environmental factor affecting the black colour character.

.....
.....

② **Give reason for** : the tail, ears and legs are black-coloured, while the rest body is white-coloured.

.....
.....

③ **How to explain** : the new grown hair under the ice-bag is black-coloured ?

.....
.....
.....
.....

- Continue : Genes Interaction (Complementary genes and Lethal genes).
- Effect of Environmental Conditions on the Action of Some Genes.



Interactive test

The questions signed by measure the high levels of thinking.

First

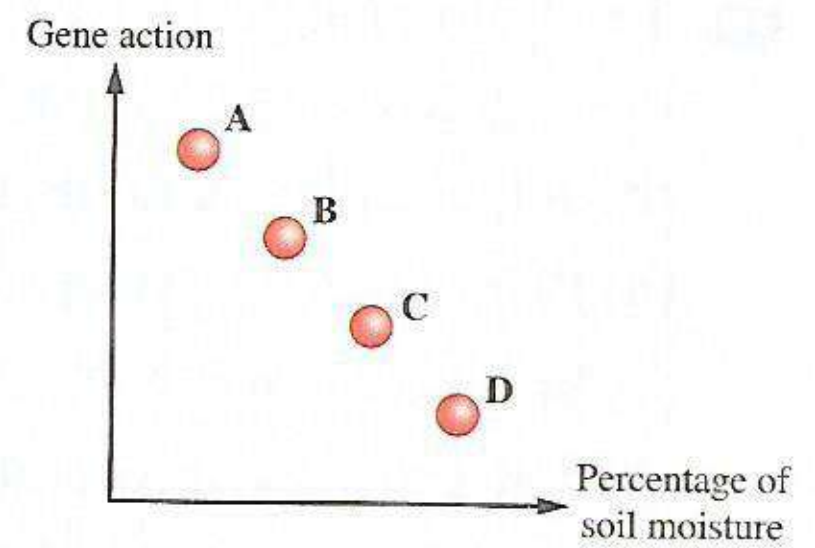
Multiple Choice Questions

- The genotype which leads to the appearance of pink colour in the flowers of pea flower plant is
 (a) Aabb (b) AaBb (c) aaBB (d) aabb
- When the crossing of two pea flower plants whose genotypes are (AAbb) and (aaBb) takes place, they produce 40 plants. So, the number of the white-flowered plants in the resulted generation is
 (a) 40 (b) 30 (c) 20 (d) 10
- When crossing two pea flower plants with genotype (AABb), the percentage of white flowers in the resulted generation is
 (a) 0% (b) 25% (c) 50% (d) 75%
- When crossing a white-flowered pea plant with a pink-flowered one, there were $\frac{3}{8}$ of the offspring are pink-flowered and $\frac{5}{8}$ were white-flowered, which of the following represents the parents' genotypes ?
 (a) AAbb × AaBb (b) Aabb × AABb (c) Aabb × AaBb (d) AAbb × aaBB
- Which of the following choices expresses the percentage of the resulted generation from crossing two pea flower plants, one of them carries the genotype (AaBB) and the other carries the genotype (aaBB) ?
 (a) 50% aaBB : 50% AaBB (b) 100% AaBB
 (c) 75% AaBB : 25% aaBB (d) 75% aaBB : 25% AaBb
- When crossing two white-flowered sweet pea plants, the ratio of the resulted generation is 3 white : 1 pink, what are the possible parents' genotypes ?
 (a) AAbb × aaBb (b) AaBb × aabb
 (c) Aabb × AABb (d) aaBB × AAbb
- The inheritance of the flower's colour character in pea plant is different from the inheritance of the flower's colour character in pea flower plant (sweet pea) in that the
 (a) inheritance of the character is controlled by dominant and recessive genes.
 (b) character has two different phenotypes.
 (c) dominant character is the pink colour.
 (d) inheritance of the character is controlled by a pair of genes.

- 8 Which of the following genotypes leads to the emergence of pink colour in pea flower plant (sweet pea) when performing a self-pollination with another plant carrying the same genotype ?
- (a) Aabb (b) AaBb (c) aaBB (d) aabb
-
- 9 The percentage of gametes (ab) that are produced when crossing two pea flower plants with genotypes (AaBB) and (aaBb) is
- (a) 25% (b) 50% (c) 75% (d) 100%
-
- 10 The inheritance of the flower's colour character in pea flower plant is characterized by the than that in *Antirrhinum* plant.
- (a) inheritance of the character which is controlled by two pairs of genes.
 (b) inheritance of the character which is controlled by a pair of genes.
 (c) phenotype that indicates the genotype.
 (d) character that has three phenotypes.
-
- 11 Which of the following crossings produce half the offspring carrying the dominant character in pea flower plant ? [Choose two answers]
- (a) AAbb × aaBb (b) AAbb × aaBB (c) aaBB × Aabb
 (d) Aabb × aaBb (e) aaBb × aabb
-
- 12 The number of male and female gametes that are resulted from crossing two pea flower plants with genotype (AaBb) is
- (a) 2 (b) 4 (c) 6 (d) 8
-
- 13 The inheritance of the flowers colour character in pea flower plant (sweet pea) is similar to that of the yellow fur colour character in mice in that both of them
- (a) have two different phenotypes.
 (b) have a character which is represented by two pairs of genes.
 (c) containing genes complement to each other to emerge the character.
 (d) have a character which is represented by a pair of genes.
-
- 14 The number of male and female gametes' types resulted when crossing two pea flower plants with genotypes (Aabb) and (aaBB) is
- (a) 3 (b) 4 (c) 5 (d) 6
-
- 15 The percentage of the mice lost when crossing a yellow-coloured male with a grey-coloured female is
- (a) 50% (b) 33% (c) 25% (d) 0%

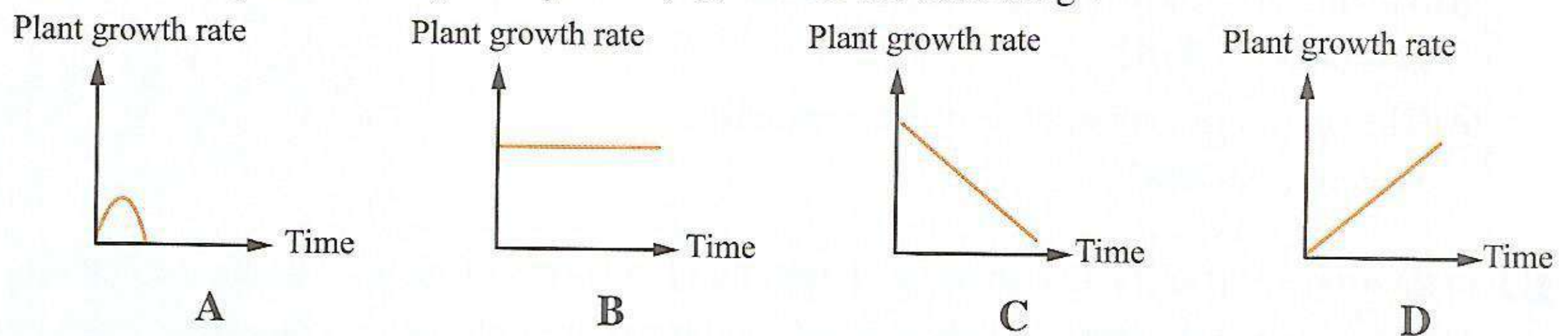
- 16 ✎ When a crossing occurs between yellow mice male and female, after multiple births 18 yellow mice and 9 grey mice were produced. So, it is expected that the number of dead mice in the uterus is
- (a) 18 (b) 9 (c) 3 (d) 0
-
- 17 When crossing two yellow-coloured mice, the number of the resulted offspring after birth was 12 mice. So, the number of yellow-coloured mice is about
- (a) 3 (b) 4 (c) 6 (d) 8
-
- 18 The dominant lethal genes differs from the recessive lethal genes in all the following, except
- (a) the genotype of the dead offspring.
 (b) the genotype of the living offspring.
 (c) the phenotype percentage for the living offspring.
 (d) the percentage of the dead offspring.
-
- 19 When getting one phenotype from crossing hybrid individuals having a gene that dominates over the other, this indicates that this case is
- (a) complete dominance. (b) lack of dominance.
 (c) dominant lethal genes. (d) recessive lethal genes.
-
- 20 The ratio between the number of phenotypes of the dominant lethal genes and that of the recessive lethal genes when crossing hybrid individuals is respectively.
- (a) 1 : 1 (b) 2 : 1 (c) 1 : 2 (d) 1 : 3
-
- 21 If you know that the legs absence character in cattles is a lethal character, due to the presence of a pair of recessive genes. So, when a normal ox is crossed with a normal cow, they produce a calf without legs and usually it dies after birth. If the same parents are mated again, therefore :
- (1) The percentage of the birth of a second calf without legs is
- (a) 0% (b) 25% (c) 50% (d) 75%
- (2) ✎ The ratio of the birth of two calves without legs from these parents is
- (a) $\frac{1}{4}$ (b) $\frac{1}{8}$ (c) $\frac{1}{16}$ (d) $\frac{1}{32}$
-
- 22 All the following are from the examples of non-mendelian characters, except the inheritance of the [Choose two answers]
- (a) flowers colour in *Antirrhinum* plant.
 (b) flowers colour in pea flower (sweet pea) plant.
 (c) flowers colour in green pea plant.
 (d) yellow fur colour in mice.
 (e) shape of green pea plant seeds.

- 23 ✨ The genes of root system formation in a plant are affected by soil moisture as shown in the opposite graph that illustrates four types of plants (A, B, C & D), which plant is better to irrigate its seedlings by immersion ?



- (a) A (b) B
(c) C (d) D

- 24 ✨ The following graphs express the growth rate of a different group of plants (A, B, C and D) that were cultivated in similar environmental conditions, if the gene of chlorophyll formation is symbolized by the symbol (C), answer the following :



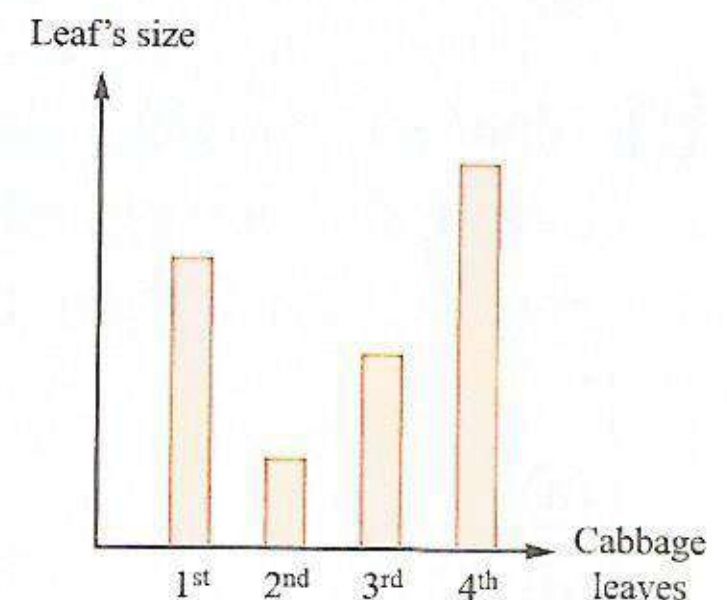
- (1) Which graph represents a corn plant whose genotype is (Cc) ?

- (a) A (b) B (c) C (d) D

- (2) Which graph represents a corn plant whose genotype is (cc) ?

- (a) A (b) B (c) C (d) D

- 25 ✨ Study the opposite graph that shows the difference in size between 4 leaves of cabbage plant, which leaf of them is more green ?



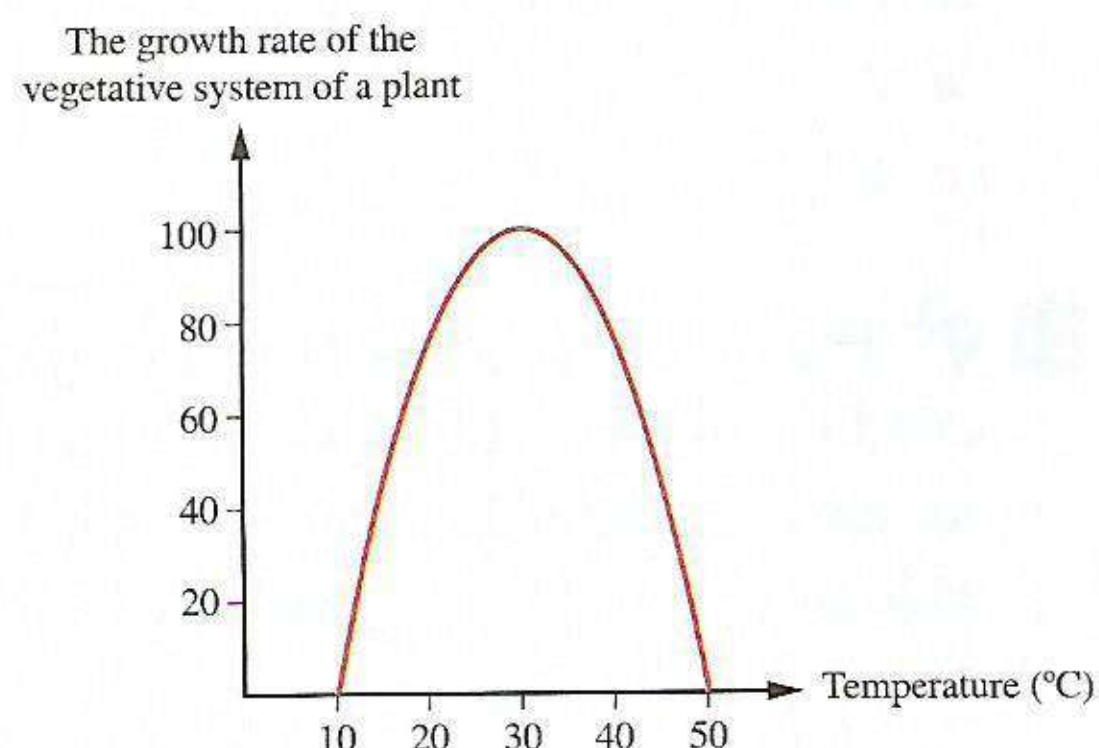
- (a) The first leaf.
(b) The second leaf.
(c) The third leaf.
(d) The fourth leaf.

- 26 At the end of 1980, in Britain a study was performed on a group of children (12 – 13 years old) to measure the rate of their intelligence, where the children subjected to IQ test before and after taking the food supplements and minerals comparing with a group of children didn't take these supplements, the first group showed improvement and progression in the intelligence rate. From the previous, we conclude that

- (a) the age is a limiting factor for intelligence in the children under study.
(b) the nutrition has an important role in growing the mental competency.
(c) the difference in the environment of the children under study affects the rate of intelligence.
(d) the difference in the genes of the children under study affects the rate of intelligence.

- 27** The following graph shows the relation between the temperature and the growth rate of the vegetative system (stem and leaves) of a plant, which of the following disagrees with the relation shown in the graph ? **[Choose two answers]**

- (a) Plant loses a large amount of water and becomes dry at 35°C.
- (b) The protein components of protoplasm become damaged at 50°C.
- (c) The optimum temperature decreases the effectiveness of the growth genes.
- (d) The highest rate of the growth genes activity is at 30°C.
- (e) The optimum temperature of the vegetative system is at 25°C.



- 28** In the tropical forests, the scientists found that the leaves of giant trees are dark green-coloured, while the leaves of short plants and grass are light green-coloured, which of the following statements represents the green colour gene in these plants ? **[Choose two answers]**
- (a) The green colour genotype changes in the leaves by changing the light intensity.
 - (b) The green colour gene is affected by the environmental factors.
 - (c) The dark green colour gene of the leaves dominates over the light green colour gene.
 - (d) The green colour gene of the leaves appears its effect in the higher leaves only.

- 29** When germinating corn seeds in a farm, the presence of yellow-coloured seedlings that lived for a short period, then wilted and died was observed. Which of the following crossings can be used to avoid this loss when cultivating new seeds ? **[Choose two answers]**

- (a) $CC \times CC$
- (b) $Cc \times Cc$
- (c) $cc \times cc$
- (d) $Cc \times cc$
- (e) $CC \times Cc$

Second

Miscellaneous Questions

- 1** When the crossing between two white-flowered sweet pea plants takes place, the individuals of the first generation are pink-coloured :
- (a) What are the parents' genotypes ?
 - (b) What is the reason for the appearance of a new character that is not present in the parents ?
- 2** "The dominant character can be obtained from two parents carrying the recessive character". How far this statement is correct ? Giving example.

- 3 ✎ The opposite table shows the resulted generation from crossing two strains of pea flower plant (sweet pea) :

♀ \ ♂	AB	.....	aB	ab
.....	....(1)....	AABb	....(2)....	AaBb
.....	....(3)....	AAbb	....(4)....	Aabb

- (a) What are the genotypes of the plants from no. (1) : (4) ?
- (b) Deduce the phenotypes of the parents.
- (c) What is the percentage of the white-flowered plants resulted from this crossing ?
- (d) What is the percentage of plants having the dominant character resulted from crossing plant no. (3) with plant no. (4) without genetic analysis ?

- 4 ✎ "The appearance of the dominant character with 56% from parents carrying the dominant character indicates that it is a complementary genes case". How far this statement is correct ? With explanation.

- 5 When a crossing occurs between two pea flower plants, each of them carries white flowers, the number of the resulted plants are, as follows :

- 557 pink-flowered plants.
- 553 white-flowered plants.

- (a) What are the possible genotypes of the parents ?
- (b) What are the expected genotypes of the resulted white-flowered plants ?

- 6 ✎ In a strain of dogs, when mating occurred between two brown-coloured dogs, all the members of the first generation were black-coloured, while in the second generation there were black and brown-coloured dogs with a ratio 9 : 7 respectively :

- (a) What is the genetic pattern of this crossing ?
- (b) What is the reason for the appearance of brown colour again ?

- 7 Give reason for : some yellow mice die inside the uterus.

- 8 Give reason for : the lethal genes are inherited from hybrid individuals only.

- 9 What happens when : germinating seedlings of corn plants in a dark place ?

- 10 In a cat strain, the female gives birth to 3 normal cats and a swelled-head cat that lived for hours before death. Explain this without genetic analysis.

- 11 What happens when : exposing the inner leaves of cabbage to light ?

- 12 ✎ When crossing an ox carrying legs absence allele (hybrid) with normal cows (AA), then the crossing takes place between the first generation individuals randomly to produce the second generation. What is the expected percentage for the adult offspring of the second generation ?

The Interaction of Genes



Choose the correct answer (1 : 10) :

- 1 Which of the following statements expresses the lack of dominance case ?
- (a) One of the genes dominates over the other gene.
 - (b) The ratio in the second generation is 3 : 1
 - (c) Each gene affects the resulted individual.
 - (d) The hybrid individual carries one of the parents character.

- 2 If we assumed the presence of yellow colour gene in a pure state in some mice. So, the expected percentage of the individuals that carry yellow colour trait is less than the normal percentage by
- (a) 33.3%
 - (b) 66.3%
 - (c) 25%
 - (d) 75%

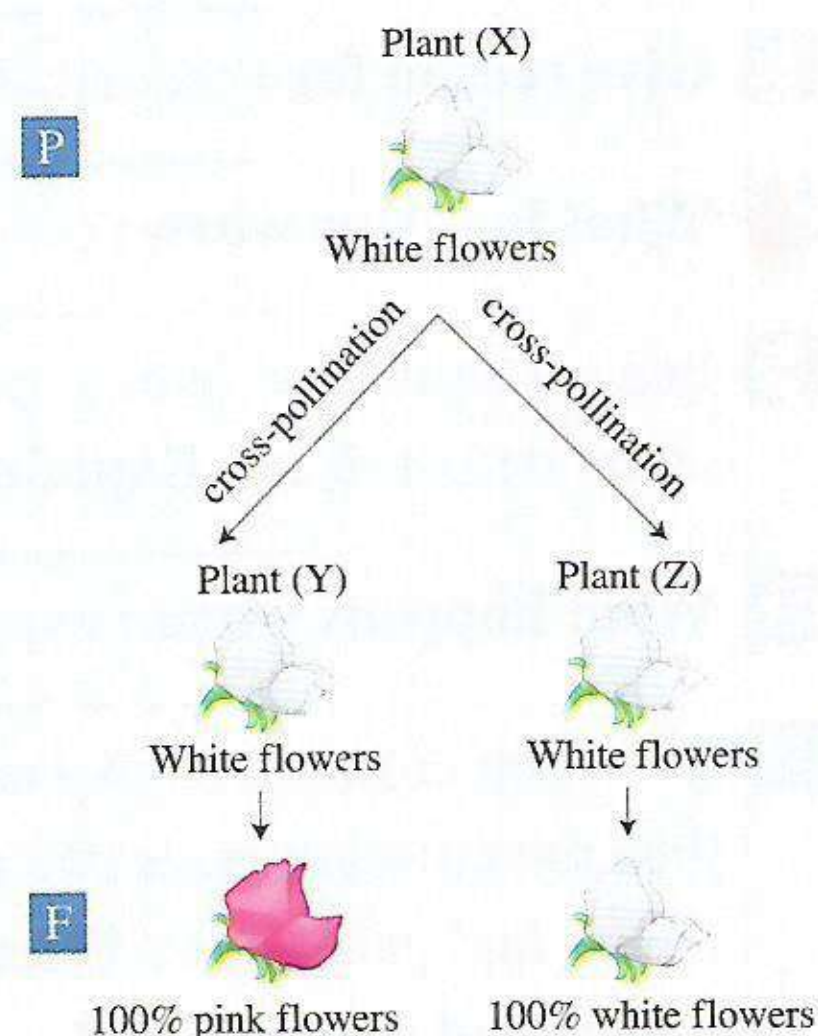
- 3 A man whose blood group is (AB) married to a woman whose blood group is (O). So, the chance of giving birth to a child with blood group (A) is
- (a) 25%
 - (b) 50%
 - (c) 75%
 - (d) 100%

- 4 The four blood groups appear in the children, if the parents' blood group genotypes are
- (a) A (hybrid) \times O
 - (b) B (hybrid) \times A (hybrid).
 - (c) AB \times AB
 - (d) A (pure) \times B (pure).

The opposite figure shows an expirement for studying the flowers colour inheritance in pea flower plant, where one of the researchers does a cross-pollination between plant (X) with the genotype (AAbb), plant (Y) and plant (Z). So, the resulted generation is shown in this figure, study it, then choose the correct answer :

- 5 The possible genotype for plant (Z) is all the following, except

- (a) Aabb
- (b) AAbb
- (c) aaBb
- (d) aabb






- 6 The possible genotype for plant (Y) is
- (a) AAbb (b) aaBB (c) aaBb (d) Aabb
-
- 7 All the following blood groups contain antigens, except
- (a) O⁻ (b) AB⁺ (c) A⁺ (d) B⁻
-
- 8 The blood group that contains the greatest number of antigens types is
- (a) O⁻ (b) AB⁺ (c) A⁺ (d) B⁻
-
- 9 When crossing RW × WW according to the lack of dominance principle, the resulted generation will have
- (a) three different genotypes and two different phenotypes.
 (b) three different genotypes and three different phenotypes.
 (c) two different genotypes and one phenotype.
 (d) two different genotypes and two different phenotypes.
-
- 10 When planting some corn seeds, all the seedlings were white-coloured, due to all the following, except
- (a) the seeds genotype is (Cc) + light absence.
 (b) the seeds genotype is (cc) + light presence.
 (c) the seeds genotype is (cc) + light absence.
 (d) the seeds genotype is (Cc) + light presence.
-

Answer the following questions (11 : 17) :

- 11 In an experiment, a grey cat crossed with another cat has the same hair colour, the resulted individuals after several births were as follows : 6 black, 12 grey and 5 white. Explain the reason for the appearance of white and black cats, despite the absence of these characters in the parents and mention the name of this case.

12 To determine the blood group of a family member, drops of anti-a, anti-b and anti-Rh were added separately to 3 drops of blood, the results were as shown in the table :

Anti-a	Anti-b	Anti-Rh
		

(a) What is the blood group of this person ?

(b) What are the blood groups whose owners can receive blood from this person ?

13 If you know that the chlorophyll formation gene in corn plant is symbolized by (C) and when germinating some corn seeds, some green seedlings emerged and the others were white. Explain this without genetic analysis.

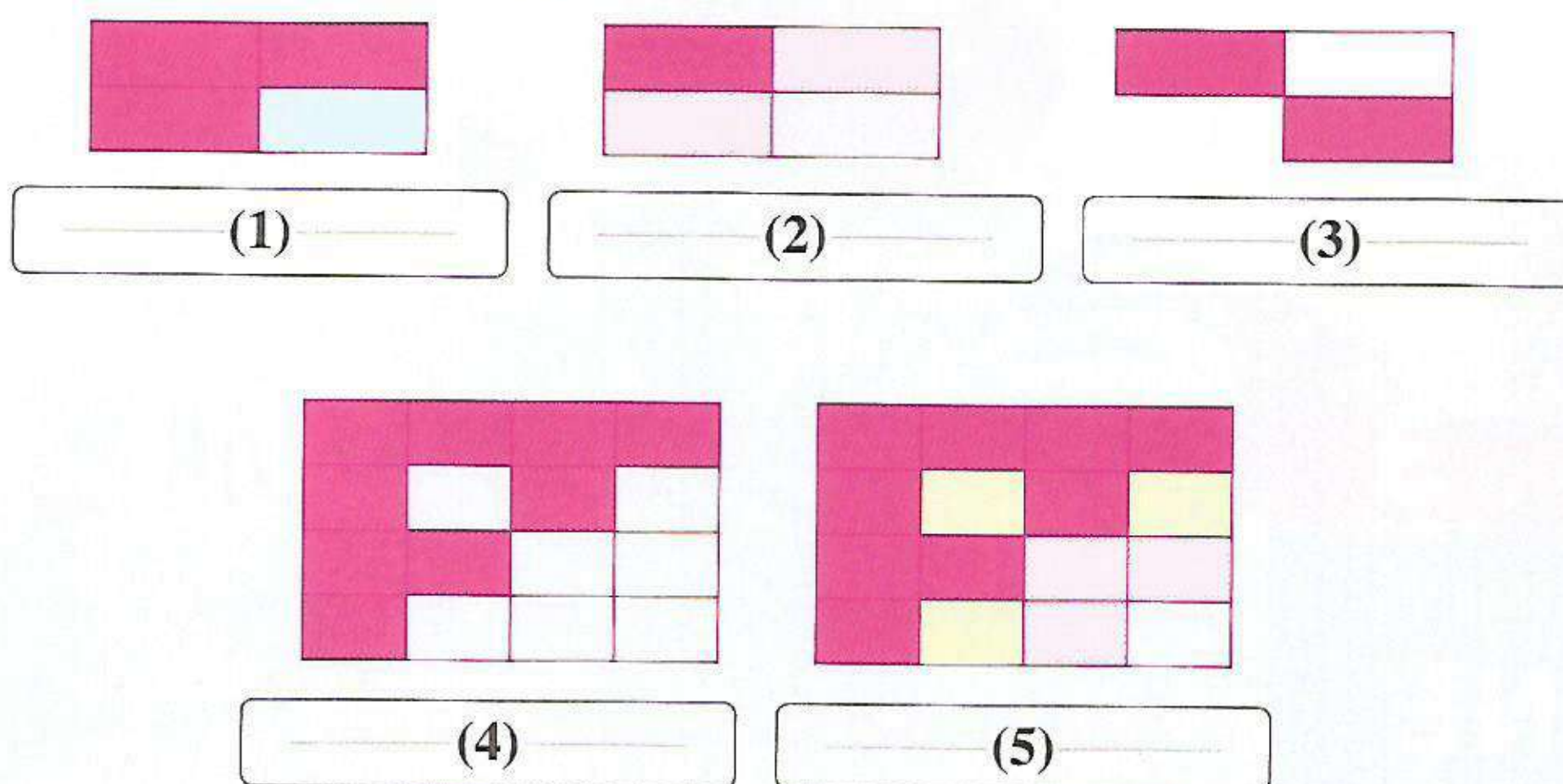
14 Fill the spaces in the following table :

	Complete dominance	Lack of dominance
1 st generation		100%
2 nd generation	3 : 1	

15 What happens in the following case :

Grey-coloured fur genes gathered in some mice. Explain your answer.

- 16 The following figures show the percentages of some genetic traits appearance, put under each figure the suitable genetic pattern :



- 17 Two men have the same blood group (O) married to two women having similar blood group, the 1st man has a baby with blood group (A) and the 2nd man has a baby with blood group (B). **What are the blood groups of the two women ? Without genetic analysis.**



CHAPTER 3

LESSON ONE

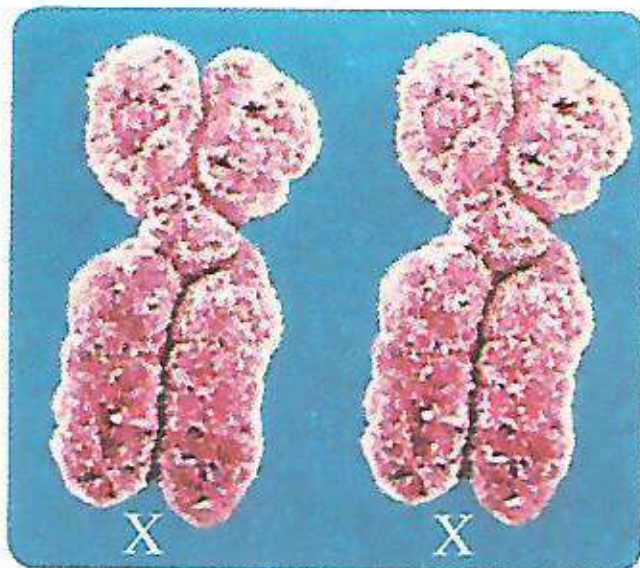
- **Sex Determination in Human.**
- **Abnormal Chromosomal Cases in Human.**

Sex determination in human

- By discovering the sex chromosomes, scientists reached that the man is responsible for determining the sex of the fetus (male or female) not the woman as was believed before until the middle of the last century.
- In the nucleus of the human somatic cells, there are 23 pairs of chromosomes (46 chromosomes) which are classified into :
 - ① **Autosomes (Somatic chromosomes)** : their number is 22 pairs (44 chromosomes) and they are similar in both male and female.
 - ② **Sex chromosomes** : their number is one pair (2 chromosomes) and they differ in the male from the female.
- We can distinguish between the human male and female cells, as follows :

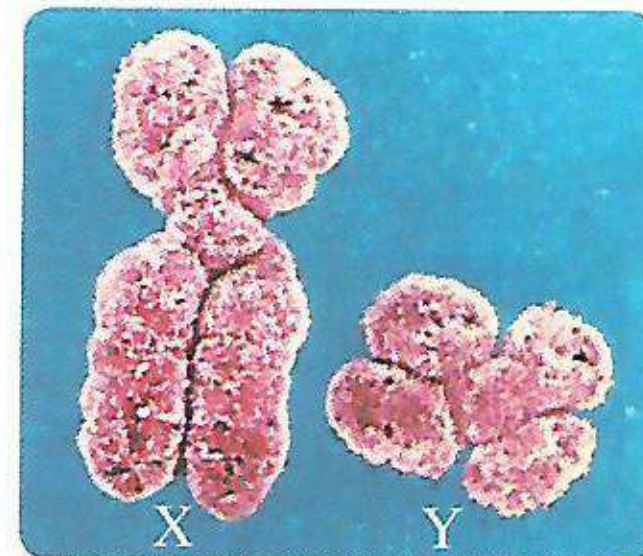
The cells in human female	The cells in human male
<ul style="list-style-type: none">• Each somatic cell contains 22 pairs of autosomes and one pair of symmetric sex chromosomes (XX).• Their chromosomal structure is (44 + XX).	<ul style="list-style-type: none">• Each somatic cell contains 22 pairs of autosomes and one pair of asymmetric sex chromosomes (XY).• Their chromosomal structure is (44 + XY).

- The gonads cells (ovaries) divide meiotically to produce one type of female gametes (ova). So, they have half the number of chromosomes that is found in the somatic cells, where each of them contains the chromosome (X). So, the chromosomal structure of the ovum is $(22 + X)$.



Sex chromosomes (XX) in female

- The gonads cells (testes) divide meiotically. So, the gametes have half the number of chromosomes that is found in the somatic cells, where the male produces two types of gametes (sperms) in equal ratios which are :
 - Sperms contain the chromosome (X) and their chromosomal structure is $(22 + X)$.
 - Sperms contain the chromosome (Y) and their chromosomal structure is $(22 + Y)$.

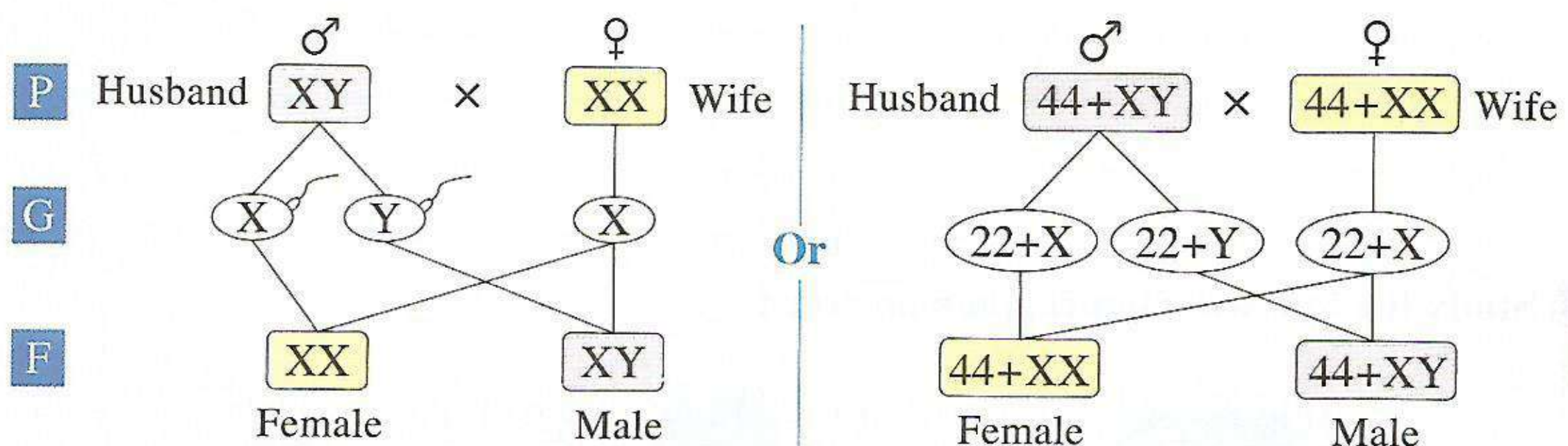


Sex chromosomes (XY) in male

- The sex chromosome (X) differs from the sex chromosome (Y) in :
 - Size.
 - Type of genes that each one carries.

Possibilities of sex determination for the human embryo

- When a man is married to a woman, the genetic analysis shows the possibilities for giving birth to males and females, as follows :



- When an ovum $(22 + X)$ is fertilized by :
 - Sperm $(22 + X)$, a female embryo is produced $(44 + XX)$.
 - Sperm $(22 + Y)$, a male embryo is produced $(44 + XY)$.
- ∴ Sperms are responsible for determining the sex of the embryo not the ova.
- i.e. Male is responsible for determining the sex of the embryo.

- The genes carried on the two sex chromosomes (X) and (Y) that are responsible for sex determination work at the first months of pregnancy, **as follows** :

- After six weeks from the beginning of pregnancy, the fetus which carries chromosome (Y) begins to produce hormones that stimulate the gonads tissues (which are undifferentiated) to form the two testes, then the rest of the male genital organs are differentiated.
- After 12 weeks from the beginning of pregnancy, the fetus which doesn't carry chromosome (Y) begins in the formation of the two ovaries, then the rest of the female genital organs are differentiated.

Enrichment information

In some animals, sex determination depends on the environmental conditions.

Example :

Temperature to which the turtles' eggs are exposed plays a role in determining their sex, where :

- The eggs that were laid near the soil surface with high temperature hatch to females.*
- The eggs that were laid away from the soil surface with low temperature hatch to males.*

1 Test yourself

Answered

- Sex determination remains a dream for a long time. The wrong belief that the woman was responsible for determining the sex of the fetus (male or female) remained, till the middle of the last century. By discovering the sex chromosomes, scientists reached the truth. **In the light of this, what did the scientists reach after discovering the sex chromosomes ? Explain your answer.**

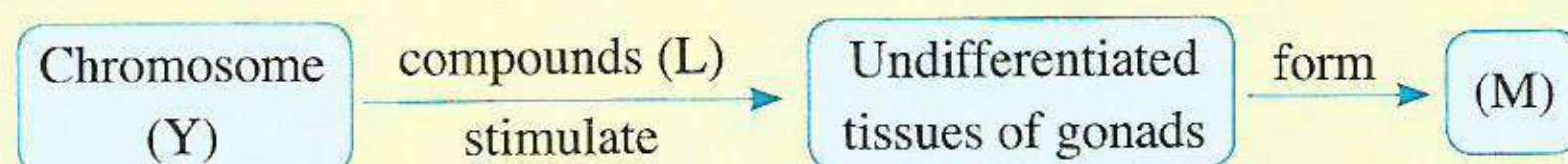
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- Study the following figure, then answer :



- (a) What do the compounds (L) represent ?

.....

- (b) What is the name of organ (M) ?

.....

Abnormal chromosomal cases in human

• The reasons for their occurrence :

These abnormal cases take place as a result of the occurrence of mistakes during the gametes formation by meiotic division, leading to a decrease or an increase in the number of sex chromosomes or autosomes. This leads to the formation of abnormal individuals after fertilization.

Note

Sometimes during gametes formation by meiotic division, the sex chromosomes pair is not equally distributed, due to their adhering closely to each other, where the whole pair of sex chromosomes transfers to one of the two gametes, while the other gamete is devoid of sex chromosomes.

• From the examples of the human abnormal chromosomal cases :

1 Klinefelter's syndrome

Case discoverer Dr. Henery Klinefelter in 1942

Reason for the case it occurs due to the fertilization of an abnormal ovum ($22 + XX$) by a normal sperm ($22 + Y$).

Type of defective chromosomes sex chromosomes.

Chromosomal structure ($44 + XXY$).

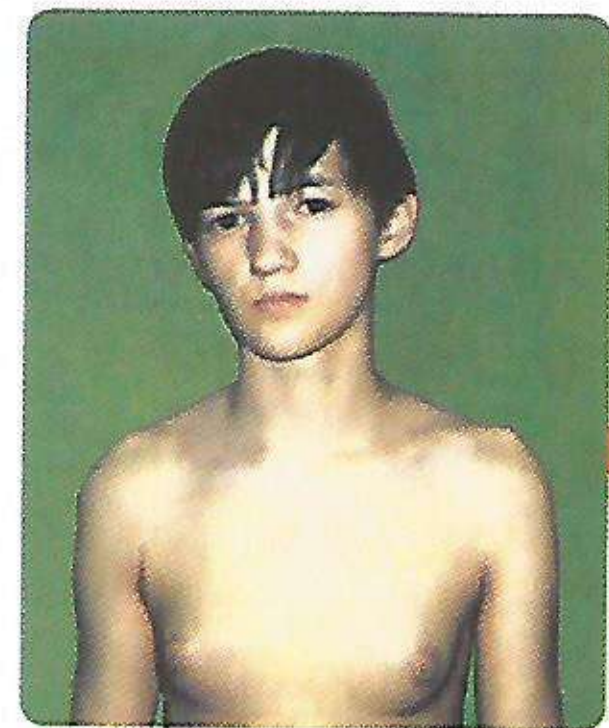
Number of chromosomes 47 chromosomes.

Sex male, due to the presence of chromosome (Y).

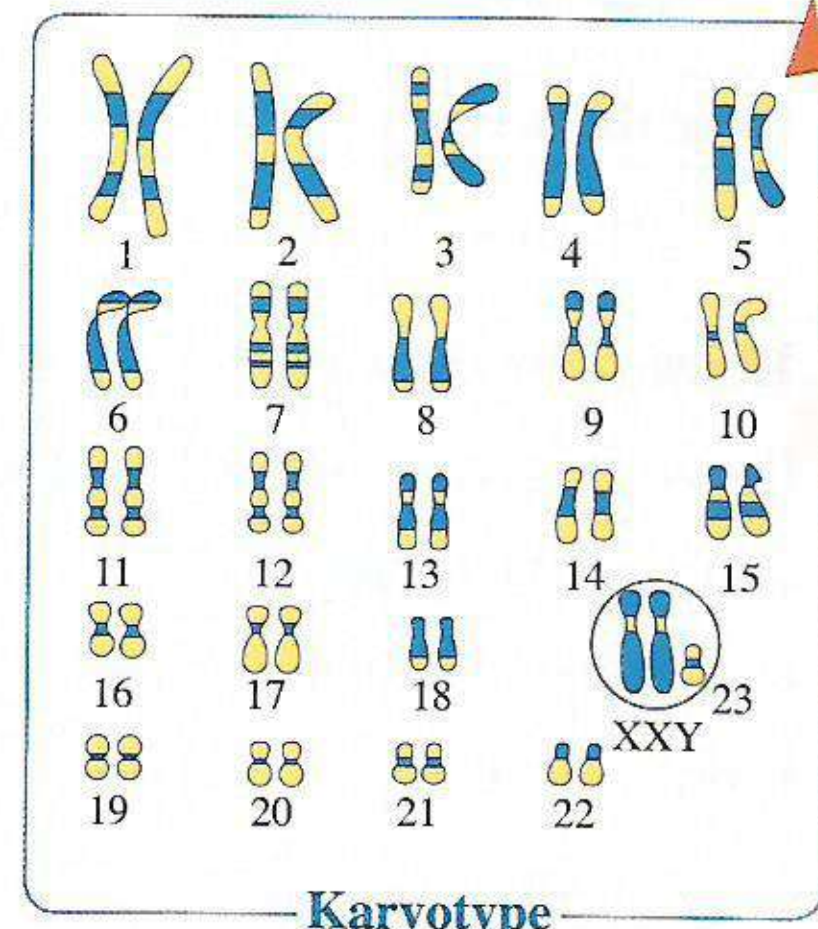
Reason for disturbance the presence of an extra chromosome (X) which leads to a disturbance in the sex hormones, where the female genes that are carried on the extra chromosome (X) express themselves in someway.

Symptoms

1. A sterile male, due to the absence of sperm generating cells.
2. Tallness.
3. The appearance of some feminine characters, such as the growth of breasts' size.



Klinefelter's syndrome



Karyotype

2 Turner's syndrome

Case discoverer Dr. Turner in 1938

Reason for the case it occurs due to the fertilization of an abnormal ovum ($22 + 0$) by a normal sperm ($22 + X$).

Type of defective chromosomes sex chromosomes.

Chromosomal structure ($44 + X0$).

Number of chromosomes 45 chromosomes.

Sex female, due to the absence of chromosome (Y).

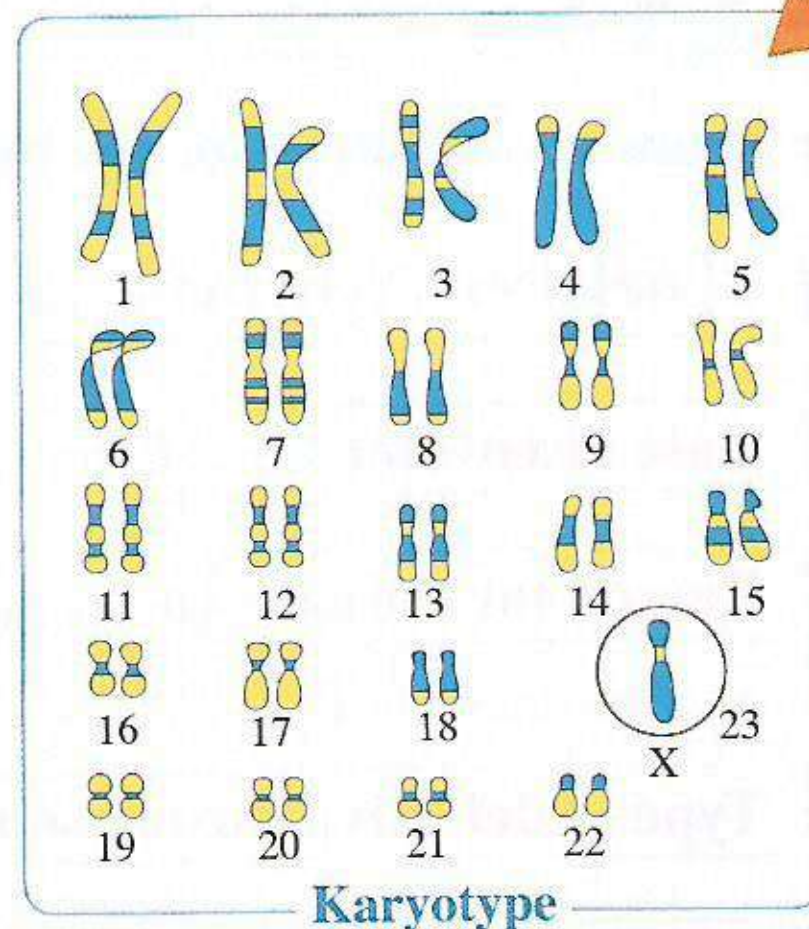
Reason for disturbance the lackage of chromosome (X) including the genes of unsexual characters that are carried on it, leading to the production of a female with several deformations.

Symptoms

1. A female who doesn't reach puberty, due to the lack of a sufficient amount of hormones.
2. The presence of some congenital defects in heart and kidneys.
3. Shortness.



Turner's syndrome



3 Down's syndrome

Case discoverer

The British doctor Down in 1866

Reason for the case

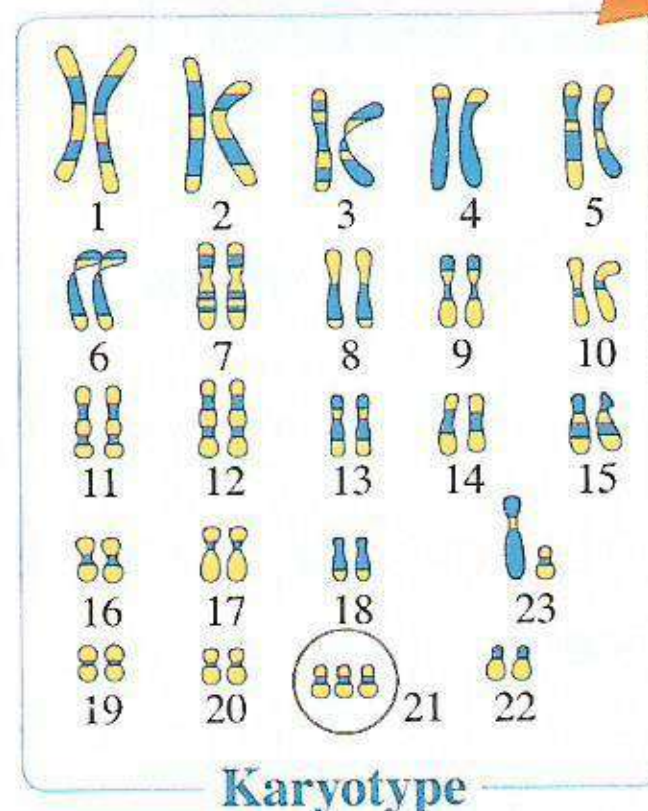
It occurs due to the fertilization of a normal gamete by an abnormal gamete (ovum or sperm) which carries a pair of chromosomes no. (21).

Type of defective chromosomes

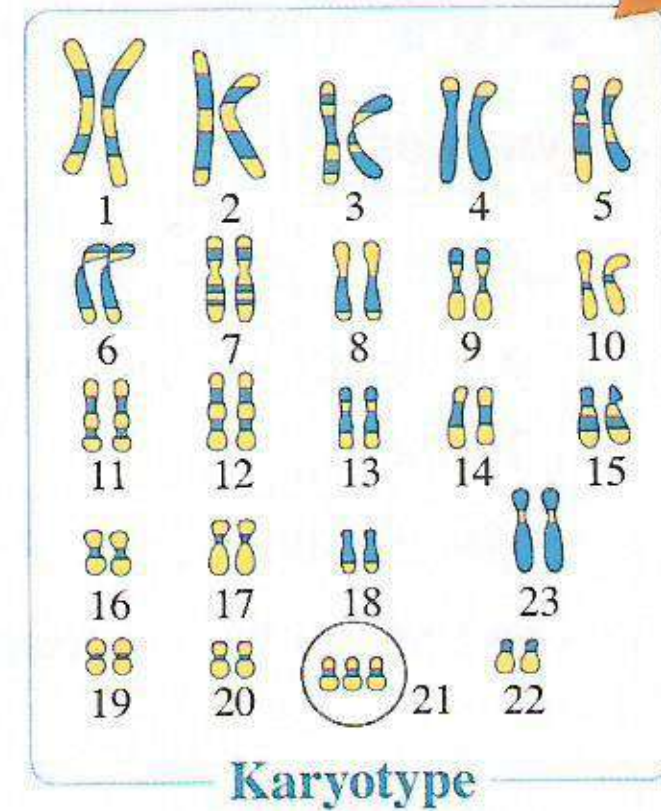
Autosomes.



Male with Down's syndrome



Female with Down's syndrome



Chromosomal structure

- Male : (45 + XY).

Or

- Female : (45 + XX).

Number of chromosomes 47 chromosomes.

Sex male or female.

Reason for disturbance the presence of three copies of the chromosome no. (21).

Symptoms

- | | | |
|------------------------|----------------------------------|------------------------|
| 1. Growth retardation. | 2. Oval face. | 3. Mental retardation. |
| 4. Shortness. | 5. The back of the head is flat. | 6. Small ears. |
| 7. Convex eyes. | 8. Fingers and toes are short. | |

Note

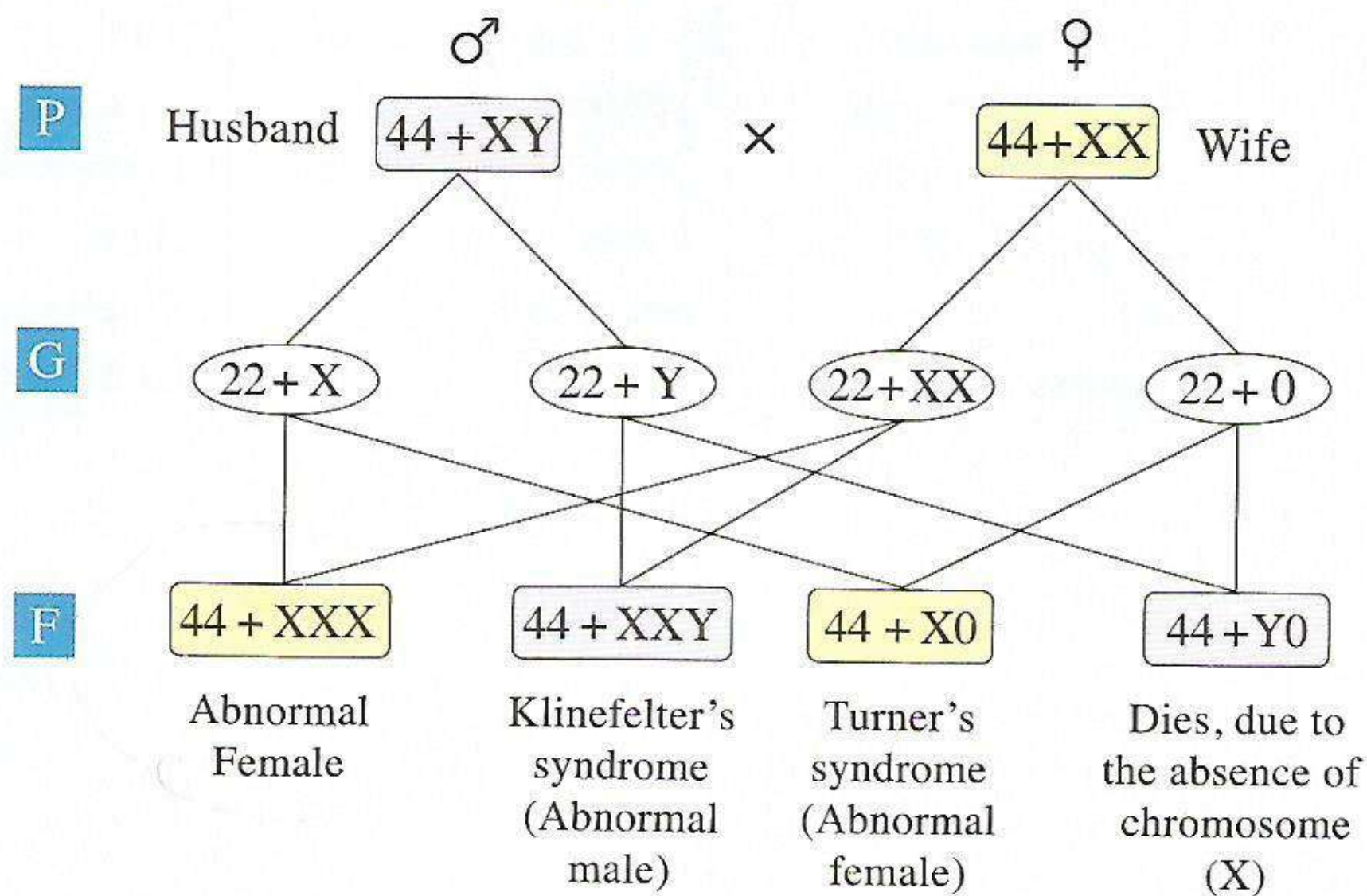
There is an abnormal chromosomal case called the polyploidy that is resulted from the fertilization of an abnormal ovum (22 + XX) with a normal sperm (22 + X). So, the chromosomal structure of the resulted individual is (44 + XXX).

Problem

When a normal man married to a normal woman, what are the possibilities of giving birth to abnormal individuals after fertilization ?

Solution

Sometimes during the formation of gametes by meiotic division, the pair of sex chromosomes is not distributed equally, as a result of their adhesion to each other. So, the possibilities of giving birth to abnormal individuals, as follows :



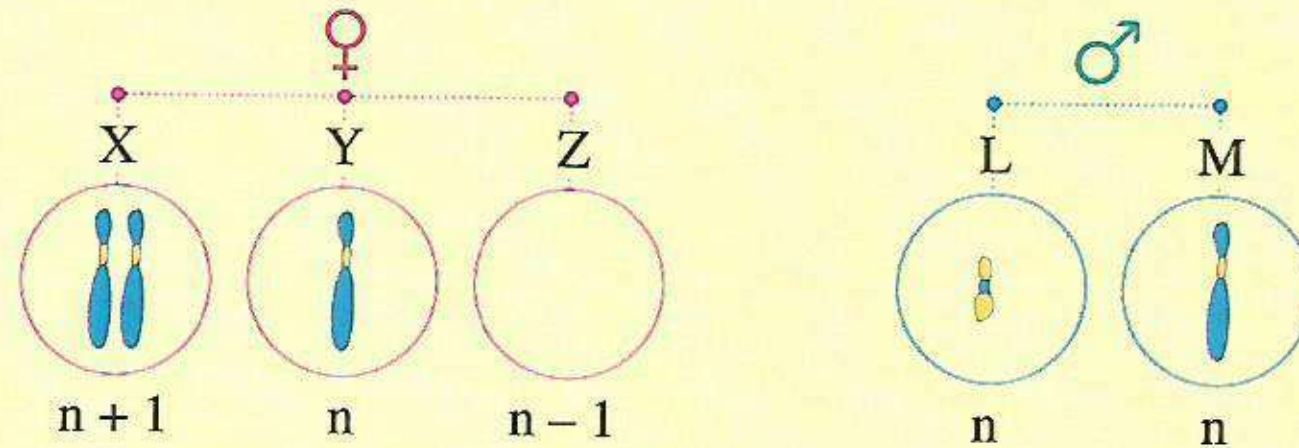
★ From the previous we can compare between the abnormal chromosomal cases in human, as follows :

P.O.C.	Klinefelter's syndrome	Turner's syndrome	Down's syndrome (Mongolism)
The reason for the case :	Fertilization of an abnormal ovum (22 + XX) by a normal sperm (22 + Y).	Fertilization of an abnormal ovum (22 + 0) by a normal sperm (22 + X).	Fertilization of a normal gamete by an abnormal gamete (sperm or ovum) that carries a pair of chromosomes no. (21).
Type of defective chromosomes :	Sex chromosomes (An extra chromosome (X)).	Sex chromosomes (A lackage of chromosome (X)).	Autosomes (Three copies of chromosome no. (21)).
The chromosomal structure :	(44 + XXY).	(44 + X0).	- Male : (45 + XY). - Female : (45 + XX).
Number of chromosomes :	47 chromosomes.	45 chromosomes.	47 chromosomes.
The sex :	Abnormal male, due to the presence of chromosome (Y).	Abnormal female, due to the absence of chromosome (Y).	Abnormal male or abnormal female.
Symptoms :	<ul style="list-style-type: none"> - A sterile male, due to the absence of the sperm generating cells. - The appearance of some feminine characters, such as the growth of breasts' size. - Tallness. 	<ul style="list-style-type: none"> - A female who doesn't reach puberty, due to the lack of a sufficient amount of hormones. - The appearance of some congenital defects in heart and kidneys. - Shortness. 	<ul style="list-style-type: none"> - Growth retardation. - Oval face. - Mental retardation. - Shortness. - The back of the head is flat. - Fingers and toes are short. - Small ears. - Convex eyes.

2 Test yourself

Answered

The following figures represent some human gametes containing sex chromosomes, study them, then choose the correct answer :



- (1) The individual who is resulted from the fusion of gamete (X) with gamete (L) after fertilization is
 - (a) a normal male.
 - (b) a male with Klinefelter's syndrome.
 - (c) a normal female.
 - (d) a female with Turner's syndrome.
- (2) The individual who is resulted from the fusion of gamete (Z) with gamete (M) after fertilization is
 - (a) a normal male.
 - (b) a male with Klinefelter's syndrome.
 - (c) a normal female.
 - (d) a female with Turner's syndrome.
- (3) The individual who is resulted from the fusion of gamete (Y) with gamete (M) after fertilization is
 - (a) a normal male.
 - (b) a male with Klinefelter's syndrome.
 - (c) a normal female.
 - (d) a female with Turner's syndrome.
- (4) The individual who is resulted from the fusion of gamete (Y) with gamete (L) after fertilization is
 - (a) a normal male.
 - (b) a male with Klinefelter's syndrome.
 - (c) a normal female.
 - (d) a female with Turner's syndrome.

For illustration only

Some autosomal disturbances in human

Type of disturbance	Disturbance	Main symptoms
Disturbances resulted from recessive genes :	Albinism	Lack of the pigment in skin, hair and eyes.
	Cystic fibrosis	The build-up of sticky mucus in lungs can cause breathing problems and increases the risk of lung infections over time, lungs may stop working, mucus clogs the pancreas and also bowel obstruction, in newborn babies-surgery may be needed.
	Galactosaemia	The accumulation of galactose sugar in the tissues, mental retardation and the damage of liver and eyes.
	Phenylketonuria	The accumulation of phenylalanine in tissues, the shortage of the skin pigment and mental retardation.
	Tay-Sach's disease	The accumulation of fats in the brain cells, mental retardation, blindness and the death of the newborn babies.
Disturbances resulted from dominant genes :	Achondroplasia	<ul style="list-style-type: none"> • Abnormal hand appearance with persistent space between the long and the ring fingers. • Bowed legs. • Decreased muscle tone. • Prominent forehead. • Shortened arms and legs.
	Huntington disease	Mental retardation and uncontrolled movements usually appear in the person's thirties or forties.
	Atherosclerosis	The increase in blood cholesterol and heart disease.

• Sex Determination in Human.
• Abnormal Chromosomal Cases in Human.



Interactive test

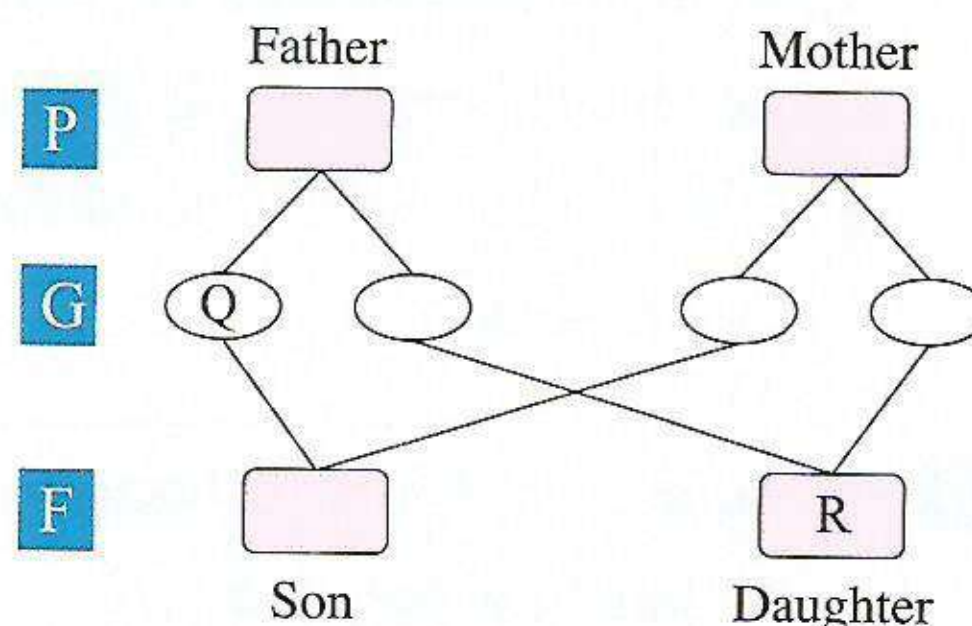
The questions signed by measure the high levels of thinking.

First

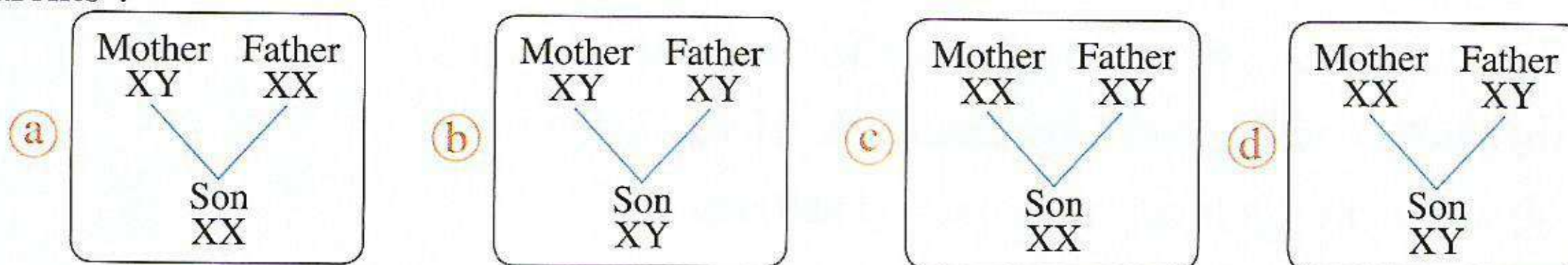
Multiple Choice Questions

- 1 The opposite diagram shows that a man married to a woman and gave birth to a son and a daughter, what are the sex chromosomes in (Q) and (R) respectively ?

	Q	R
(a)	X	XX
(b)	X	XY
(c)	Y	XX
(d)	Y	XY



- 2 Which crossing of the following shows how a son inherits the sex chromosomes from his parents ?



- 3 If you know that the number of chromosomes in a skin cell of a female dog is (2X), answer the following :

- (1) The number of autosomes in the nucleus of the sperm is
 (a) X (b) 2X (c) 2X - 2 (d) X - 1
- (2) The number of autosomes in the nucleus of a stomach cell of a male dog is
 (a) X (b) 2X (c) X - 1 (d) 2X - 2
- (3) The number of chromosomes in the nucleus of the kidney cell of a female dog is
 (a) X (b) 2X (c) X - 2 (d) X - 1

- 4 Which of the following statements is not applied to the sex chromosome (X) in human ?

[Choose two answers]

- (a) It is larger in size than chromosome no. (8) in the karyotype of the ovum.
 (b) Its increase leads to a disturbance in the sex hormones.
 (c) Its presence causes the differentiation of gonads in the sixth week of pregnancy.
 (d) It differs from sex chromosome (Y) in size and in the type of the carried genes.
 (e) It is larger in size than chromosome no. (7) in the karyotype of the ovum.

- 5 The two following figures illustrate the karyotype in the *Drosophila* insect, it can be concluded that

[Choose two answers]

- (a) somatic chromosomes differ in male from female.
- (b) the genes carried on the sex chromosome (X) are similar to that on the sex chromosome (Y).
- (c) the male is responsible for the sex determination.
- (d) the female is responsible for the sex determination.
- (e) each of male and female contains the long sex chromosome.

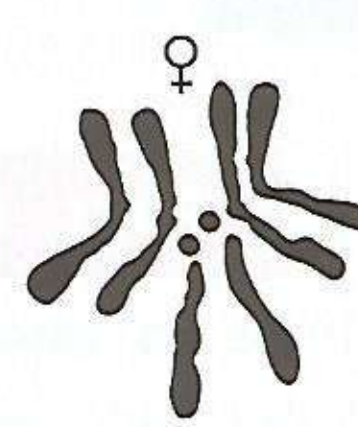


Figure (1)

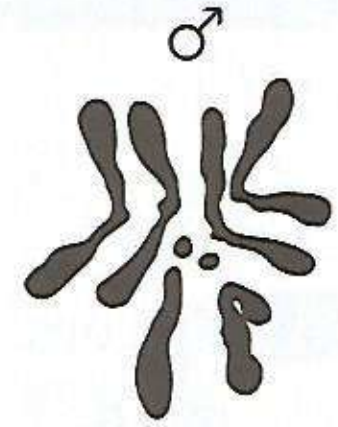


Figure (2)

- 6 The formation of the two testes in the fetus starts after about months(s) from the beginning of pregnancy.

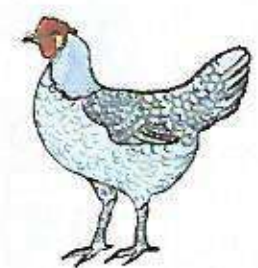
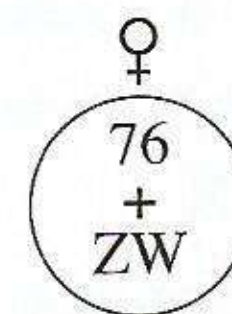
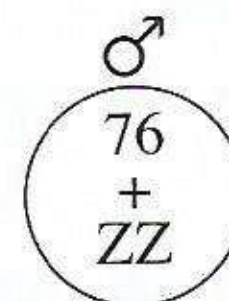
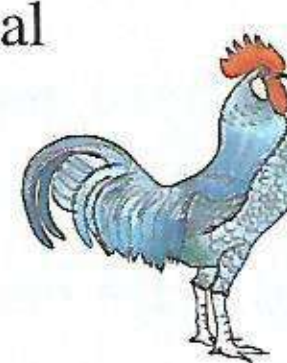
- (a) one
- (b) one and half
- (c) two
- (d) three

- 7 If the human embryo doesn't contain chromosome (Y), the from the beginning of pregnancy.

- (a) genital organs are differentiated after one and half month
- (b) genital organs are differentiated after three months
- (c) sexual growth ceases after one and half month
- (d) masculinity hormones are activated for the sex determination

- 8 The two opposite figures show the chromosomal structure in chicken, study it, then answer :

- (1) All the following statements are correct, except that



- (a) both sexes carry the necessary chromosome for life.
- (b) the females are responsible for the sex determination.
- (c) the males are responsible for the sex determination.
- (d) both sexes are similar in the number of autosomes.

- (2) The number of autosomes in the pancreatic cell of the hen is

- (a) 76
- (b) 39
- (c) 38
- (d) 2


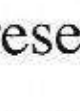
- (3) The number of autosomes in the sperm of the cock is

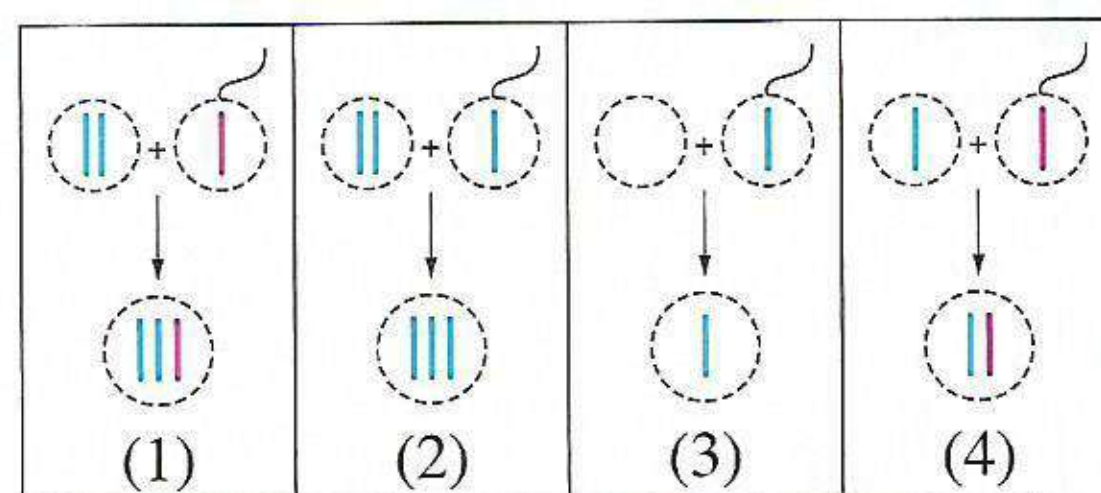
- (a) 76
- (b) 39
- (c) 38
- (d) 2


- 9 The following figures illustrate the stages of the human embryo formation in weeks, study them, then answer :



- (1) The gender of the embryo is determined
- (a) before the first week. (b) during the first week.
(c) in the 5th week. (d) in the 6th week.
- (2) The two testes in male are differentiated in the week.
(a) 5th (b) 7th (c) 9th (d) 16th
- (3) The two ovaries in female are formed in the week.
(a) 5th (b) 7th (c) 8th (d) 13th
-
- 10 If a normal sperm that doesn't contain the sex chromosome (X) can fertilize a normal ovum. So, a may appear.
(a) Turner's case (b) Klinefelter's case
(c) normal female (d) normal male
-
- 11 The individual that is resulted from the fertilization of a normal ovum by a sperm (22 + X) is a
(a) male with Klinefelter's syndrome. (b) female with Turner's syndrome.
(c) normal female. (d) normal male.
-
- 12 When an ovum devoid of sex chromosomes is fertilized by a sperm (22 + Y),
(a) a normal male is produced. (b) a normal female is produced.
(c) an abnormal male is produced. (d) the ovum dies after fertilization.
-
- 13 The male with Klinefelter's syndrome is similar to the male with Down's syndrome in the
(a) number of sex chromosomes. (b) presence of chromosome (Y).
(c) number of chromosomes (X). (d) number of autosomes.
-
- 14 The male in Down's syndrome is different from the female in the
(a) number of sex chromosomes. (b) number of autosomes.
(c) type of sex chromosomes. (d) case symptoms.

- 15** The opposite figures represent 4 different cases of fertilization in human (knowing that  represents the male gamete and  represents the female gamete), study them, then answer :

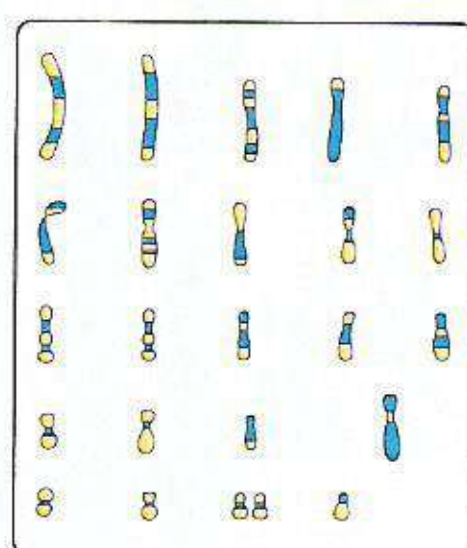
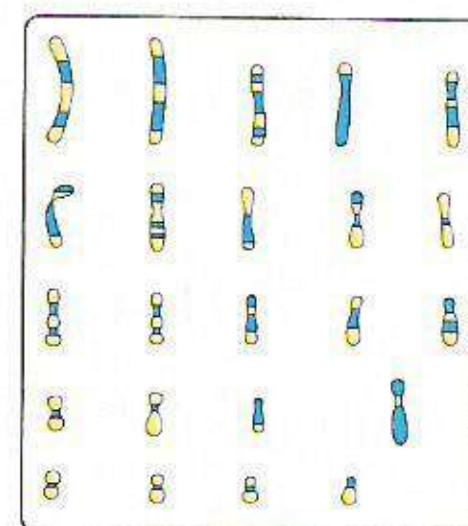


- (1) Which of the following is produced from the fertilization of a gamete with the chromosomal structure $(n - 1)$?
- (a) (1). (b) (2). (c) (3). (d) (4).
- (2) Which of the following suffers from the short stature ?
- (a) (1). (b) (2). (c) (3). (d) (4).
- (3) Which of the following produces a sterile male ?
- (a) (1). (b) (2). (c) (3). (d) (4).
- (4) Which of the following produces sex gametes containing chromosome (Y) ?
- (a) (1). (b) (4). (c) (1) & (4). (d) (2) & (4).
-
- 16** A female with Turner's syndrome is similar to a female with Down's syndrome in the
- (a) number of sex chromosomes. (b) number of autosomes.
(c) case symptoms. (d) absence of chromosome (Y).
-
- 17** The number of autosomes in the ovum of a normal female is
- (a) 22 (b) 23 (c) 45 (d) 46
-
- 18** The number of chromosomes in a somatic cell of a female with Down's syndrome is
- (a) 22 (b) 23 (c) 45 (d) 47
-
- 19** When an ovum $(23 + X)$ is fertilized by a sperm containing chromosome (X), is produced.
- (a) a normal female (b) a male with Klinefelter's syndrome
(c) a female with Down's syndrome (d) a female with Turner's syndrome
-
- 20**  If a normal sperm fertilized a human female ovum that contains 24 chromosomes including only one sex chromosome that differs from the sex chromosome of the sperm, may appear.
- (a) Klinefelter's syndrome (b) Turner's syndrome
(c) a male with Down's syndrome (d) a female with Down's syndrome

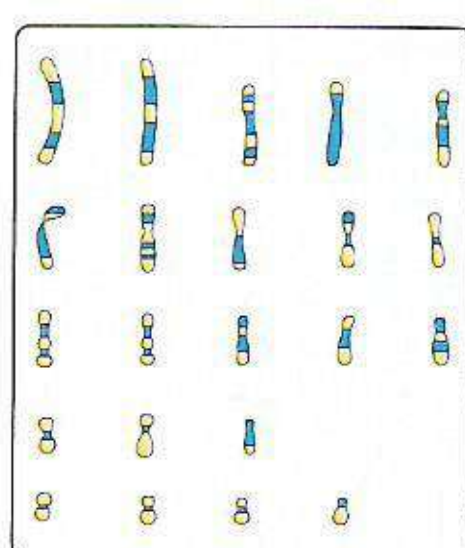
21 Which of the following cells contains the least number of chromosomes ?

- (a) A liver cell of a normal male.
- (b) A muscle cell from the intestine of a female with Down's syndrome.
- (c) A kidney cell of a female with Turner's syndrome.
- (d) A skin cell of a male with Klinefelter's syndrome.

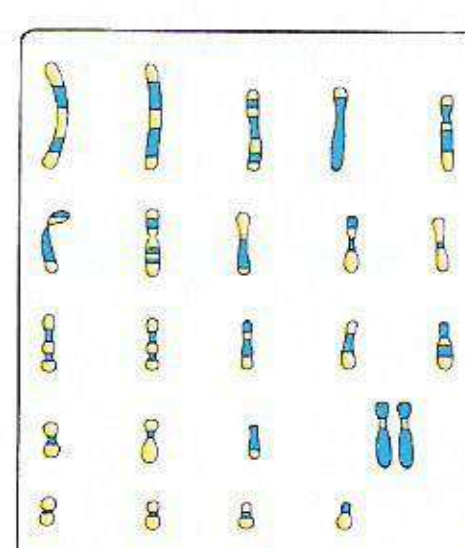
22 The opposite figure represents the karyotype of a human sperm, when fertilization occurred to the ovum, the resulted baby was a female suffering from congenital defects in the heart, which of the following represents the karyotype of the fertilized ovum ?



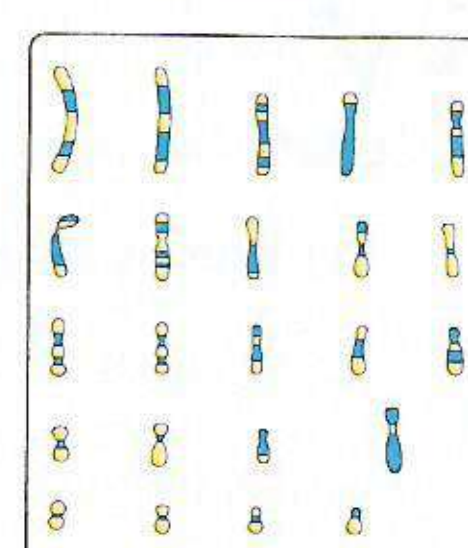
(a)



(b)



(c)

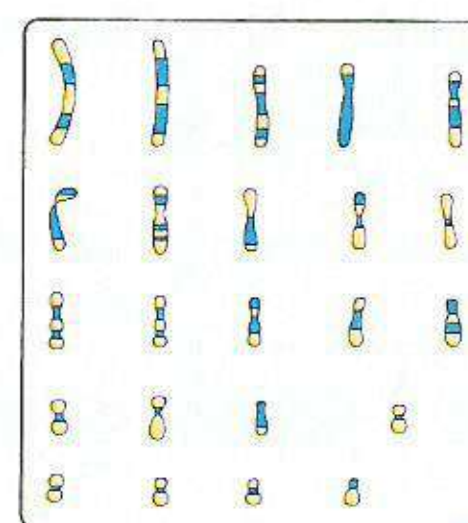


(d)

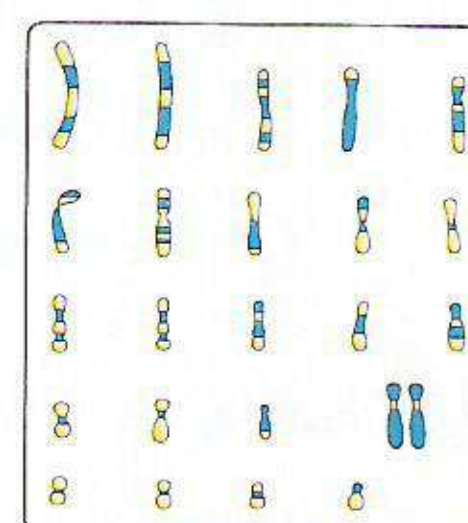
23 What is the ratio between the number of sex chromosome (X) in the skin cell of a normal human male and the same cell in a female respectively ?

- (a) 2 : 1
- (b) 1 : 1
- (c) 1 : 2
- (d) 2 : 2

24 The two opposite figures represent the karyotype of two gametes no. (1) and (2), what is the case resulted from the fertilization process between them ?



(1)



(2)

- (a) Klinefelter's syndrome.
- (b) Turner's syndrome.
- (c) Down's syndrome.
- (d) Polyploidy.

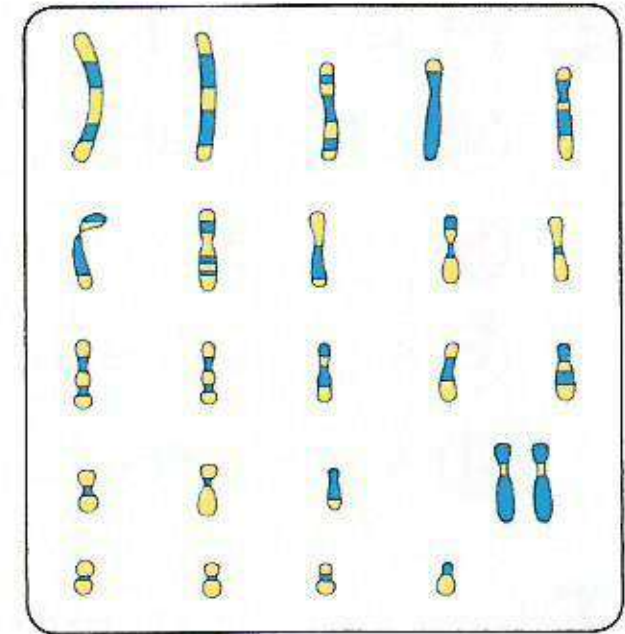
25 Which of the following includes a skin cell of that contains 46 chromosomes ?

- (a) Down's syndrome.
- (b) Turner's syndrome.
- (c) Klinefelter's syndrome.
- (d) Normal female.

26 Look at the opposite figure, then answer the following questions :

(1) The opposite karyotype represents a(an)

- (a) normal sperm.
- (b) normal ovum.
- (c) abnormal sperm.
- (d) abnormal ovum.



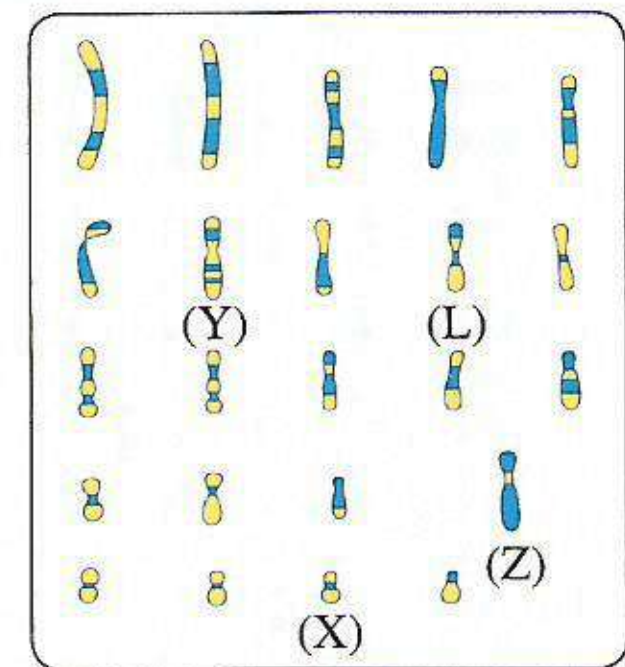
(2) Which of the following can be produced from the fusion of this gamete with another normal gamete ?

- (a) Polyploidy.
- (b) Turner's syndrome.
- (c) A female with Down's syndrome.
- (d) Normal female.

27 Look at the opposite figure, then answer the following questions :

(1) The opposite karyotype represents a(an)

- (a) normal sperm.
- (b) normal ovum.
- (c) abnormal ovum.
- (d) (a) or (b).



(2) Which of the following chromosomes carries the gene of blood groups ?

- (a) (X).
- (b) (Y).
- (c) (Z).
- (d) (L).

(3) The absence of chromosome (Z) from this gamete and its presence in the gamete where fertilization occurs normally with it, leads to the appearance of

- (a) Klinefelter's syndrome.
- (b) Turner's syndrome.
- (c) a female with Down's syndrome.
- (d) a male with Down's syndrome.

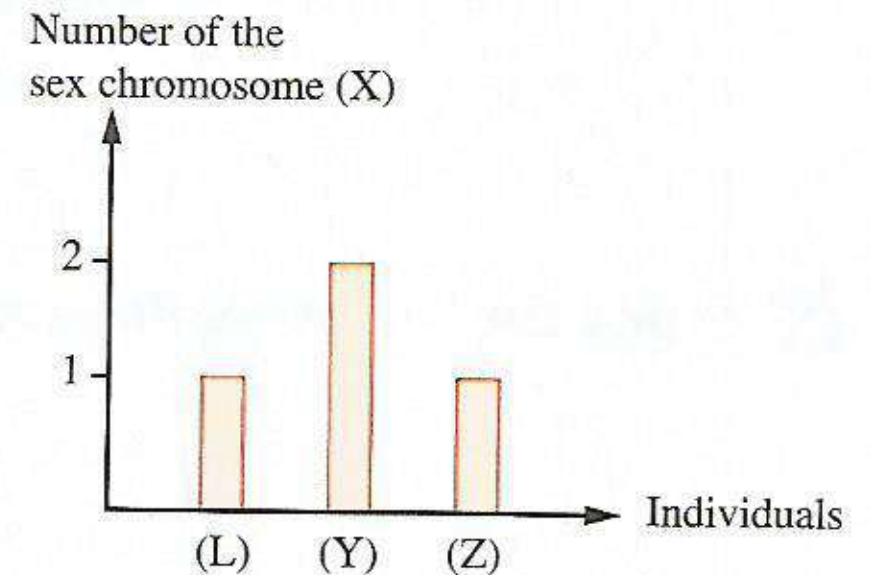
28 The person who has 45 chromosomes in his/her cells is always

- (a) male.
- (b) female.
- (c) male or female.
- (d) unspecified sex.

29 The chromosomes are present in symmetric pairs in the karyotype of

- (a) a normal male.
- (b) a male with Klinefelter's syndrome.
- (c) a female with Down's syndrome.
- (d) a normal female.

30 ✎ The following graph shows the number of the sex chromosome (X) in three somatic cells of (L), (Y) and (Z) individuals and each of them represents an abnormal chromosomal case. Answer the following according to your study :



(1) The cells of individual (L) are similar to the cells of individual (Z) in

- (a) the type of sex chromosomes.
- (b) the number of sex chromosomes.
- (c) the number of somatic chromosomes.
- (d) the order of autosomes.

(2) The cell of individual (Y) is present in

- (a) a male with Klinefelter's syndrome or a female with Turner's syndrome.
- (b) a male with Down's syndrome or a female with Turner's syndrome.
- (c) a male with Klinefelter's syndrome or a female with Down's syndrome.
- (d) a male with Down's syndrome or a female with Down's syndrome.

31 A woman went to a doctor and he told her that she was pregnant and the possible date of becoming pregnant was 1/2/2020, and the required tests were done. After 20 weeks from the beginning of pregnancy, she did a test for determining the gender of the embryo and the doctor told her that he is a male. So, it is expected that the genital tissues of the embryo started to form the two testes on

- (a) 22 / 2
- (b) 21 / 3
- (c) 18 / 4
- (d) 16 / 5

32 ✎ The embryo with Turner's syndrome begins the formation of gonads cells after

- (a) a month.
- (b) month and half.
- (c) two months.
- (d) three months.

33 What is the determinant of the baby sex ?

- (a) The father's blood group.
- (b) The father's chromosomes.
- (c) The mother's blood group.
- (d) The mother's chromosomes.

34 If the chromosomal structure of an individual is (45 + XY), this person is a

- (a) female who suffers from Down's syndrome.
- (b) female who suffers from Turner's syndrome.
- (c) male who suffers from Down's syndrome.
- (d) male who suffers from Klinefelter's syndrome.

35 If the chromosomal structure of an individual is (44 + XY), this represents a

- (a) mentally retarded male.
- (b) sterile male.
- (c) normal male.
- (d) normal female.

36 Which sex chromosome(s) is(are) present in all the mature human sperm cells ?

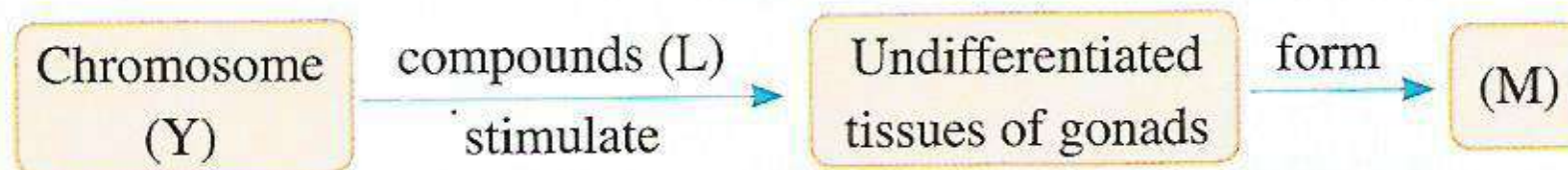
- (a) Both of chromosomes (X) and (Y).
- (b) Either chromosome (X) or (Y).
- (c) Chromosome (X) only.
- (d) Chromosome (Y) only.

Second

Miscellaneous Questions

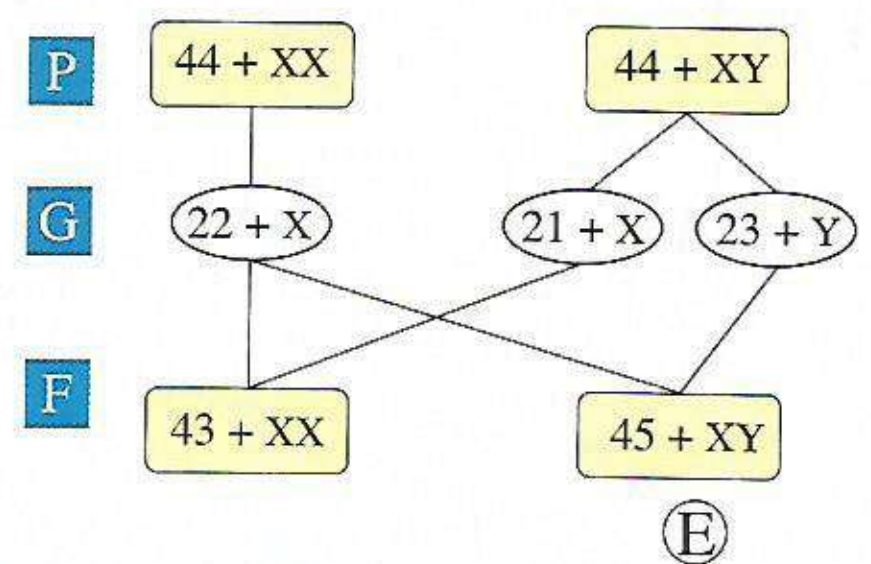
- 1** If you know that the number of chromosomes in a cat skin cell is 38 chromosomes, find :
- The number of chromosomes in the ovum.
 - The number of autosomes in the nerve cell.
 - The number of sex chromosomes in the sperm.

- 2** Study the following diagram, then answer :



- What do the compounds (L) represent ?
 - What is the name of organ (M) ?
- 3** What happens in case of : the presence of chromosome (Y) in a human fetus during the first stages of growth ?
- 4** What happens in case of : the absence of chromosome (Y) in a human fetus during the first stages of growth ?
- 5** What is the relationship between : meiosis and the appearance of both Klinefelter's syndrome and Turner's syndrome ?
- 6** A male child suffers from Patau's syndrome which means the presence of copies of the chromosome pair no. (13) :
- Which of the abnormal chromosomal cases you have studied before is similar to Patau's syndrome ?
 - Deduce the chromosomal structure of this child.
- 7** "The type of abnormal chromosomes in case of Klinefelter's syndrome differs from that in Down's syndrome". How far this statement is correct ? With explanation.
- 8** Give reason for : Klinefelter's syndrome appears in males only, whereas Turner's syndrome appears in females only.
- 9** "The sex chromosomes are not the only reason for the chromosomal abnormalities in humans". How far this statement is correct ? With explanation.
- 10** Give reason for : Down's syndrome arises in both males and females.
- 11** ✎ What is the name of the case that expresses each of the following :
- A human male genetically, but has some feminine characters.
 - A human female who has some organs don't work efficiently, due to some congenital defects in her organs, such as : the heart.

- 12** The opposite figure shows the genetic analysis of an abnormal case in human, answer the following questions, in the light of your study :



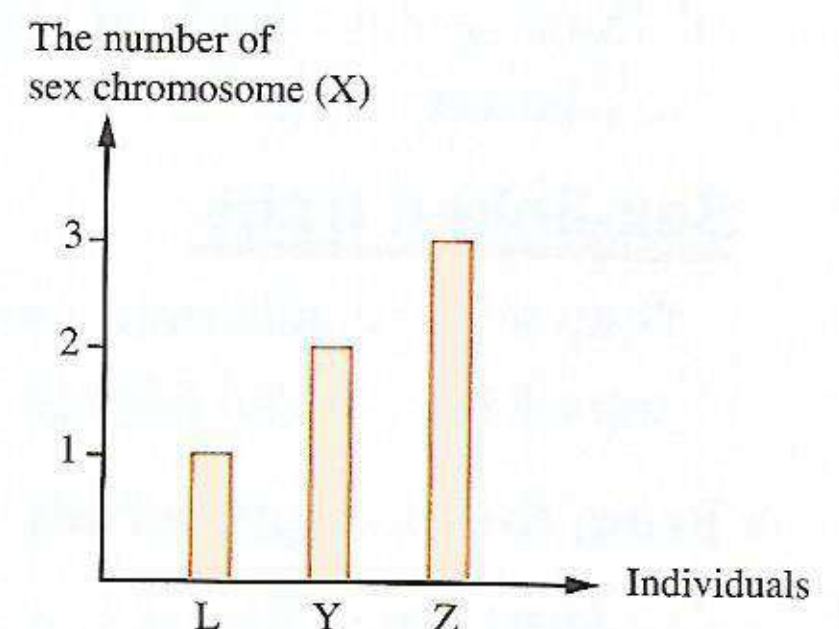
- (a) Does the error occur in the formation of sperms or ova ? Explain your answer.
- (b) Write the name of the abnormal case that is represented by the symbol (E).

- 13** "The presence of a human female with karyotype containing two sex chromosomes (XX) doesn't indicate that it is a normal female". How far this statement is correct ? With explanation.

- 14** What happens to : the number of genes in a male with Klinefelter's syndrome compared to the number of genes in a normal male has the same age and weight ? Explain your answer.

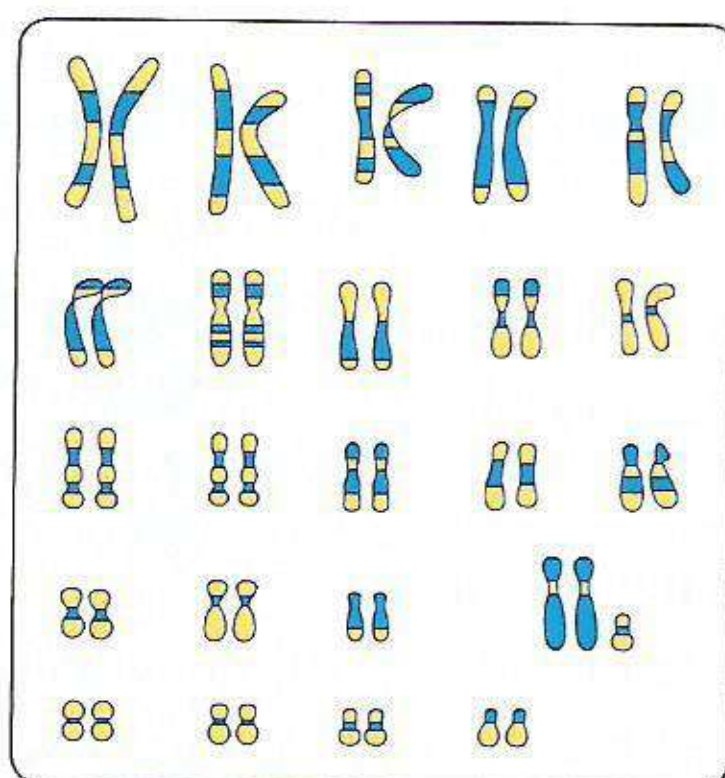
- 15** "The presence of a pair of sex chromosomes (XX) in the cell always indicates that it is a female cell". How far this statement is correct ? With explanation.

- 16** The opposite graph shows the number of sex chromosome (X) in the somatic cells of three individuals (L), (Y) and (Z), have the normal number of somatic chromosomes, study it, then answer :

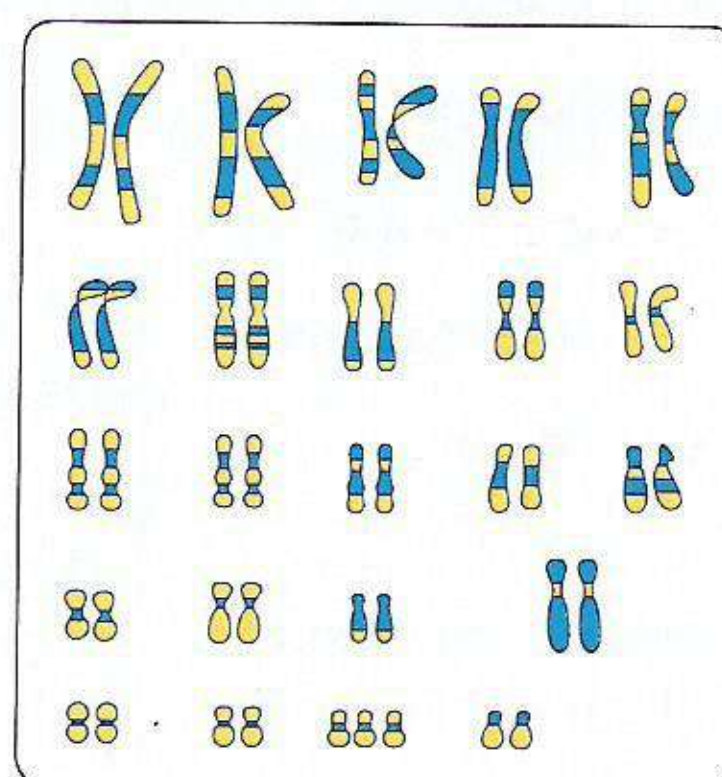


- (a) What are the possibilities of the chromosomal structure for individual (Y) ?
- (b) Mention which of these individuals may suffer from congenital defects in the circulatory and urinary systems.

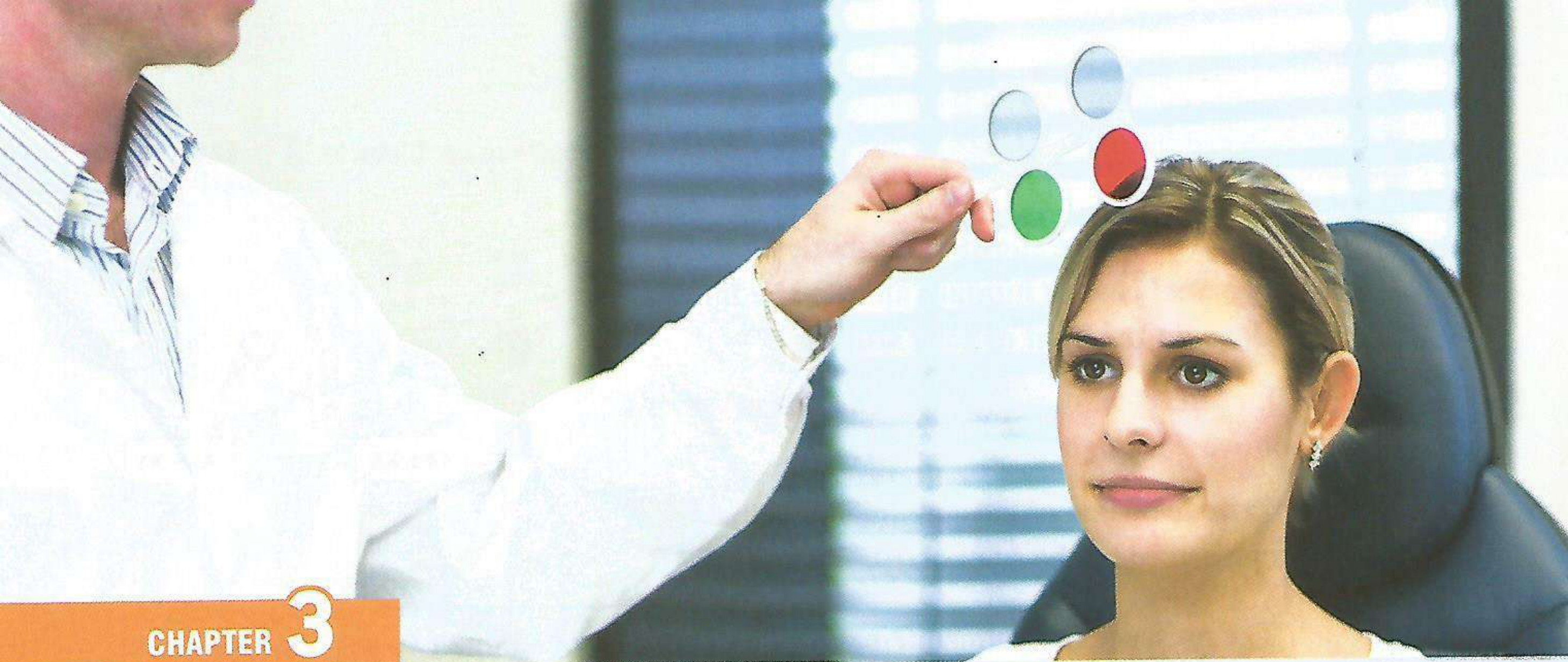
- 17** Study the two following karyotypes no. (1) and (2), then determine the error type, the name of the case and the sex for each one of them :



(1)



(2)



CHAPTER 3

LESSON TWO

- Sex-linked, Sex-influenced and Sex-limited Traits.
- Medical Examinations Before Marriage.

Sex-linked traits

Thomas Morgan

- During studying the eye colour character in *Drosophila* insect, he discovered that the genes of some somatic traits are located on the sex chromosomes. So, he named them "sex-linked traits".

Sex-linked traits

They are somatic traits that their genes are located on the sex chromosomes and their appearance is not affected by the sex hormones.

- From the examples of sex-linked traits :
 - In *Drosophila* insect : eye colour.
 - In human : colour blindness, haemophilia, short-sightedness and muscle atrophy.

A Sex-linked traits in *Drosophila* insect

- The eye colour character in *Drosophila* insect :

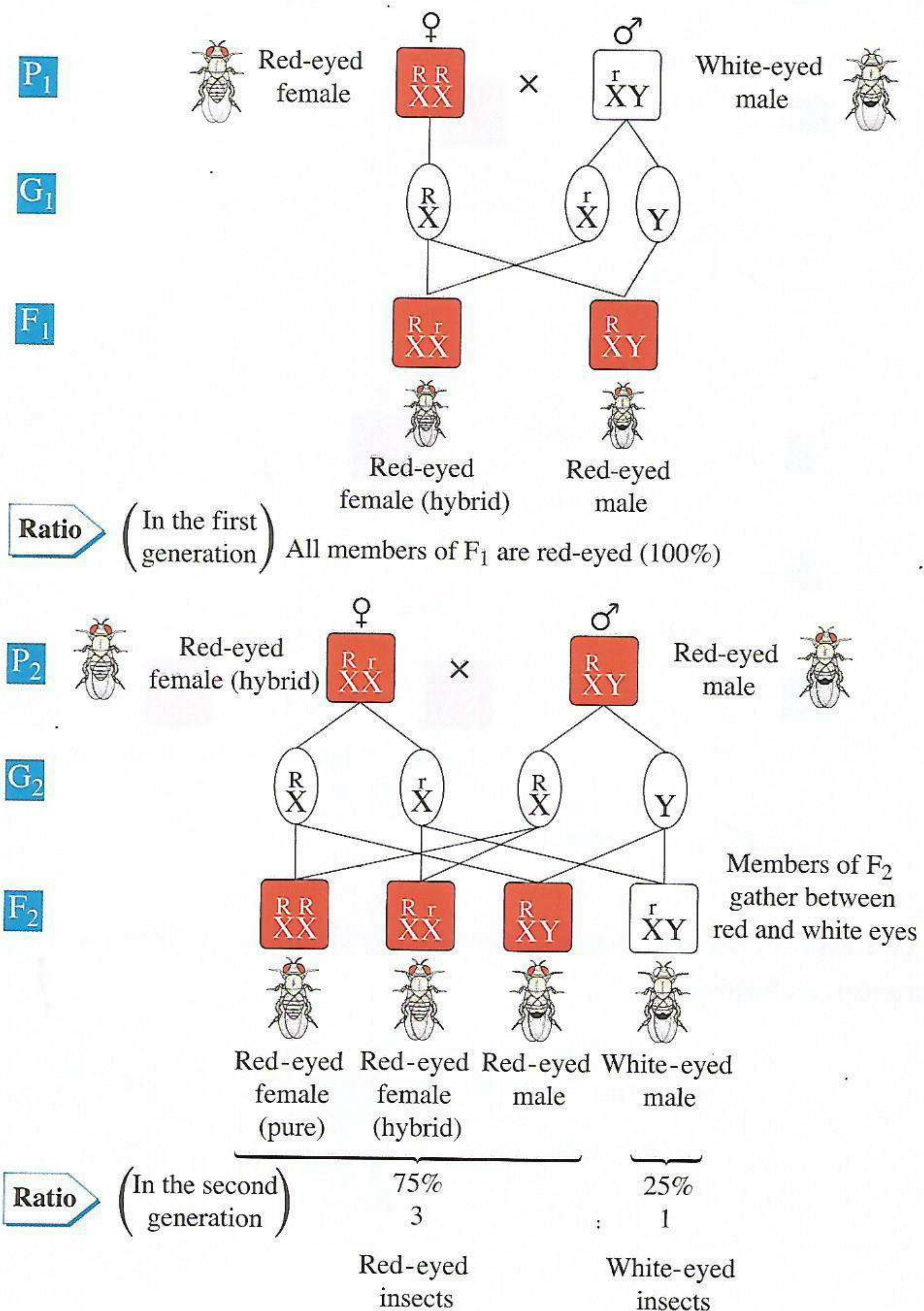
Experiment	Observation	Conclusion
1 Morgan crossed a white-eyed male ($\overset{r}{X}Y$) with a red-eyed female ($\overset{RR}{XX}$) "pure".	All the members of the first generation were red-eyed.	The red-eyed colour character is dominant over the white-eyed colour character.
2 Morgan crossed the members of the first generation with each other.	The members of the second generation were red-eyed and white-eyed with a ratio 3 : 1 respectively.	All the white-eyed individuals were males.

• From the previous, it was found that :

- Morgan could consider the eye colour character in *Drosophila* insect as a mendelian character. As the dominant character (red-eyed colour) appeared in the 1st generation with a ratio 100%, and the individuals of the 2nd generation carried the two characters (recessive and dominant) "red colour - white colour" with a ratio 3 : 1 respectively.
- Morgan considered the eye colour of the *Drosophila* insect as a sex-linked character.

Because he noticed that the quarter of the 2nd generation (25%) which carries the recessive character (white eyes) are males, where the genes of this character are carried on the sex chromosome (X), whereas the sex chromosome (Y) carries few genes of them only.

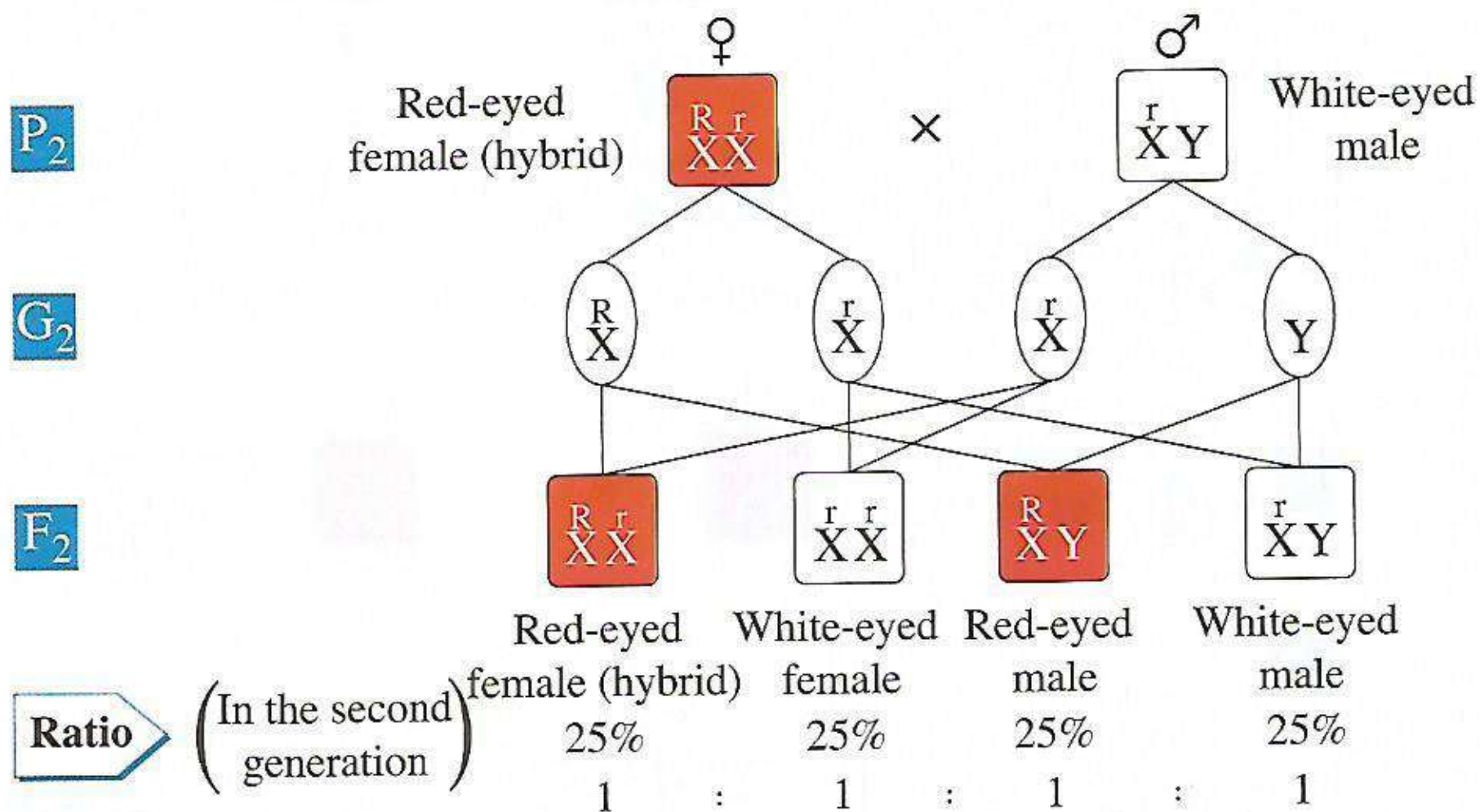
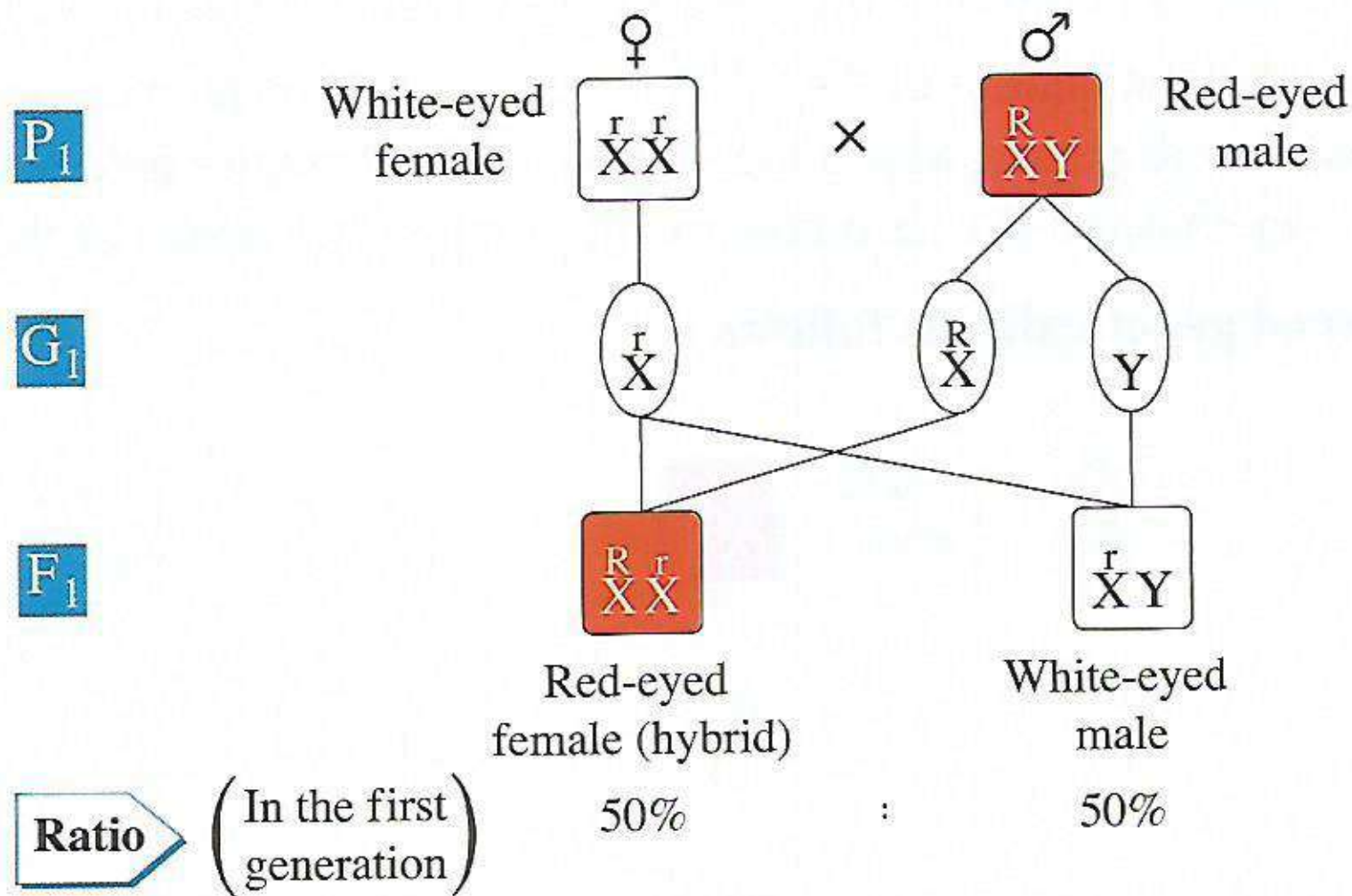
• This can be explained genetically, as follows :



Problem

What is the result of crossing a red-eyed male of *Drosophila* with a white-eyed female in the first and second generations. Explain this genetically.

Solution

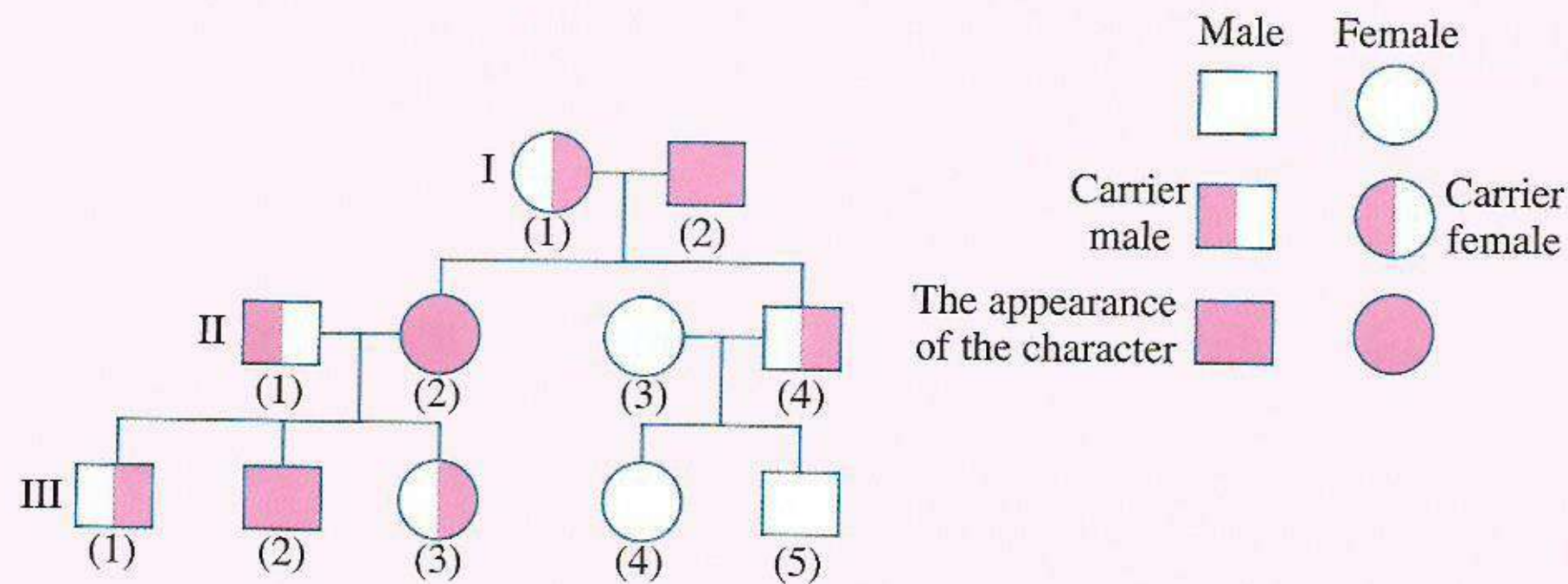


- We can explain the genotypes of the *Drosophila* male and female in the eye colour character, as follows :

Genotype	Eye colour	Red eyes	White eyes
Male :		$\frac{R}{X}Y$	$\frac{r}{X}Y$
Female :		$\frac{RR}{XX}$ $\frac{Rr}{XX}$	$\frac{rr}{XX}$

Do you know ...?

- Pedigree record (genetic map) is considered as a diagram showing the transmission of characters and their genes from a generation to another in a family, as follows :



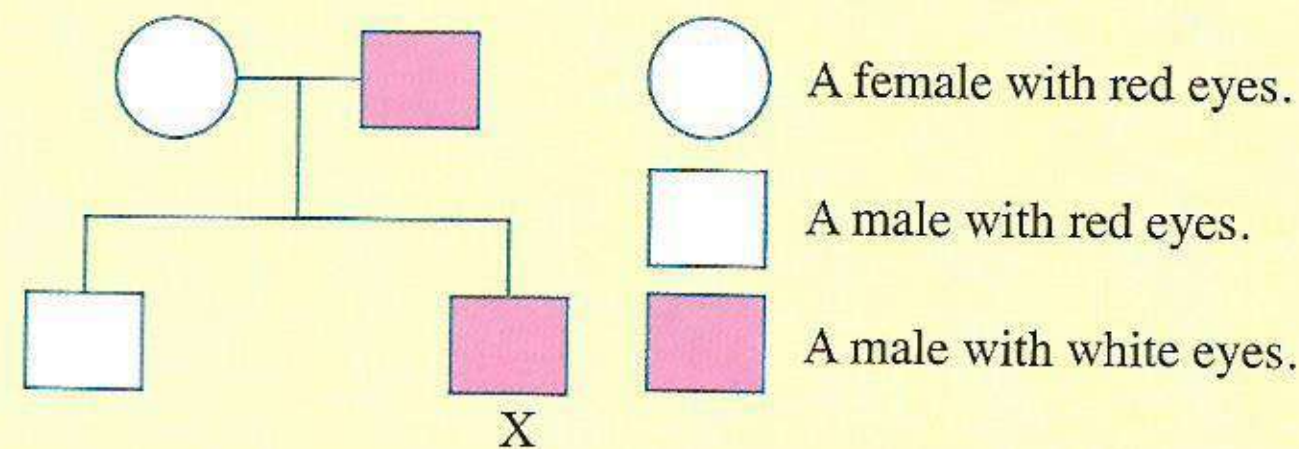
- Each generation is represented by a latin number (I, II, III) and each individual is represented by an english number (1), (2), (3) ... etc.

1 Test yourself

Answered

Choose the correct answer :

The following figure illustrates the inheritance of eye colour character in *Drosophila* insect, if an insect (X) is crossed with another insect that has the same genotype of its mother, according to the eye colour character :



What is the percentage of the white-eyed insects in the resulted generation ?

- (a) 0% (b) 50% (a) 75% (d) 100%

B Sex-linked traits in human

- In human, the chromosome (X) carries genes that are responsible for some somatic traits, such as :

- Colour blindness.
- Haemophilia (Blood liquidity).
- Short-sightedness.
- Muscles atrophy.

Enrichment information

Sex chromosome (Y) in human male carries some genes that are related to somatic characters without the presence of corresponding genes to them on the sex chromosome (X), such as the gene that is responsible for the appearance of hair on ear margins in males. So, these traits are restricted only to males.

- The father passes the genes of the previous characters to his daughters only.

- We will study the inheritance of colour blindness and haemophilia in some details :

1 Colour blindness

Colour blindness

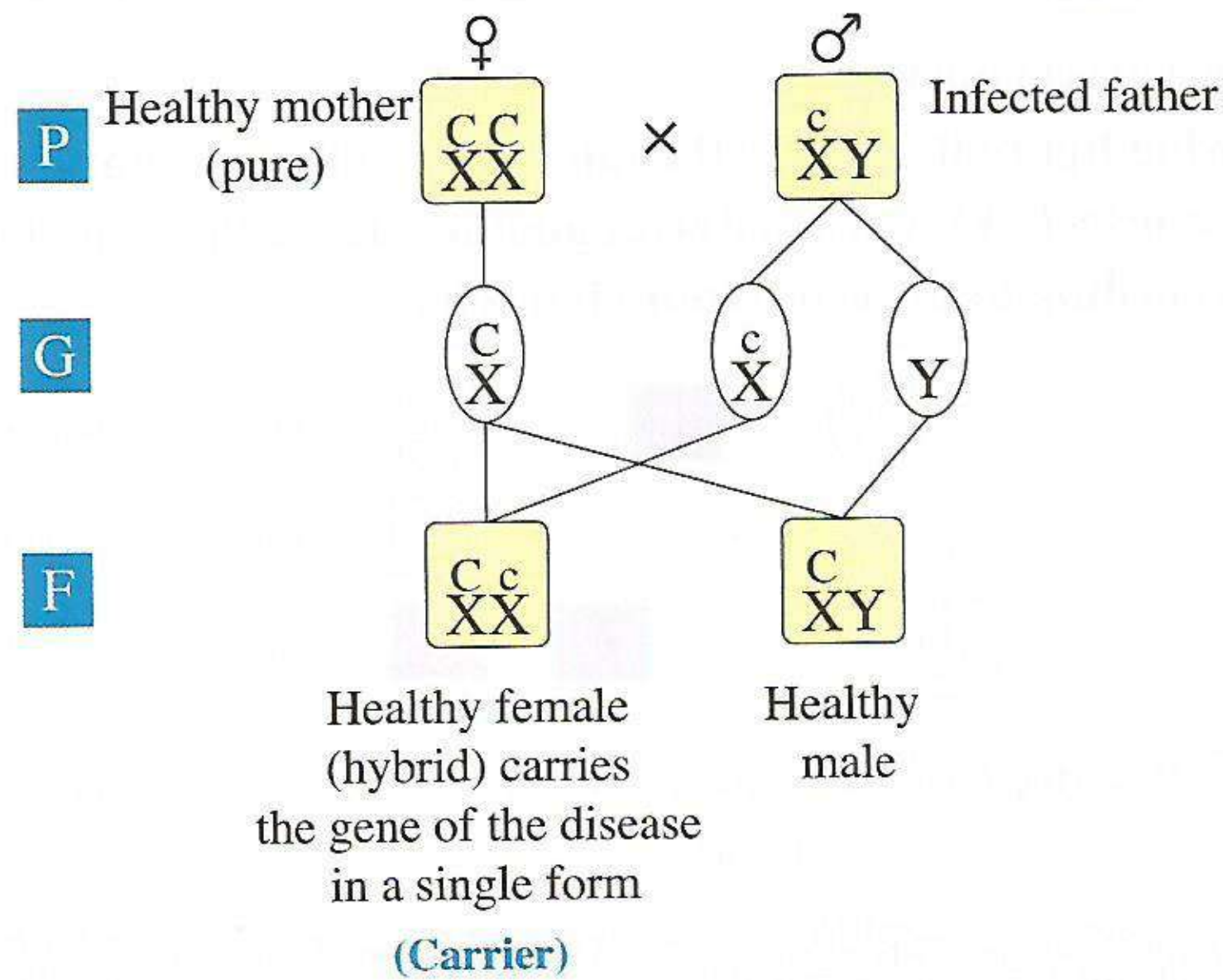
A genetic case causes the inability of distinguishing colours, especially the red and green colours.

- The case of colour blindness is caused by a **recessive gene** that is carried on the sex chromosome (X).

Example

When a colour-blinded man married to a healthy woman (pure), all members of the resulted generation are healthy.

- We can explain this case genetically, as follows :

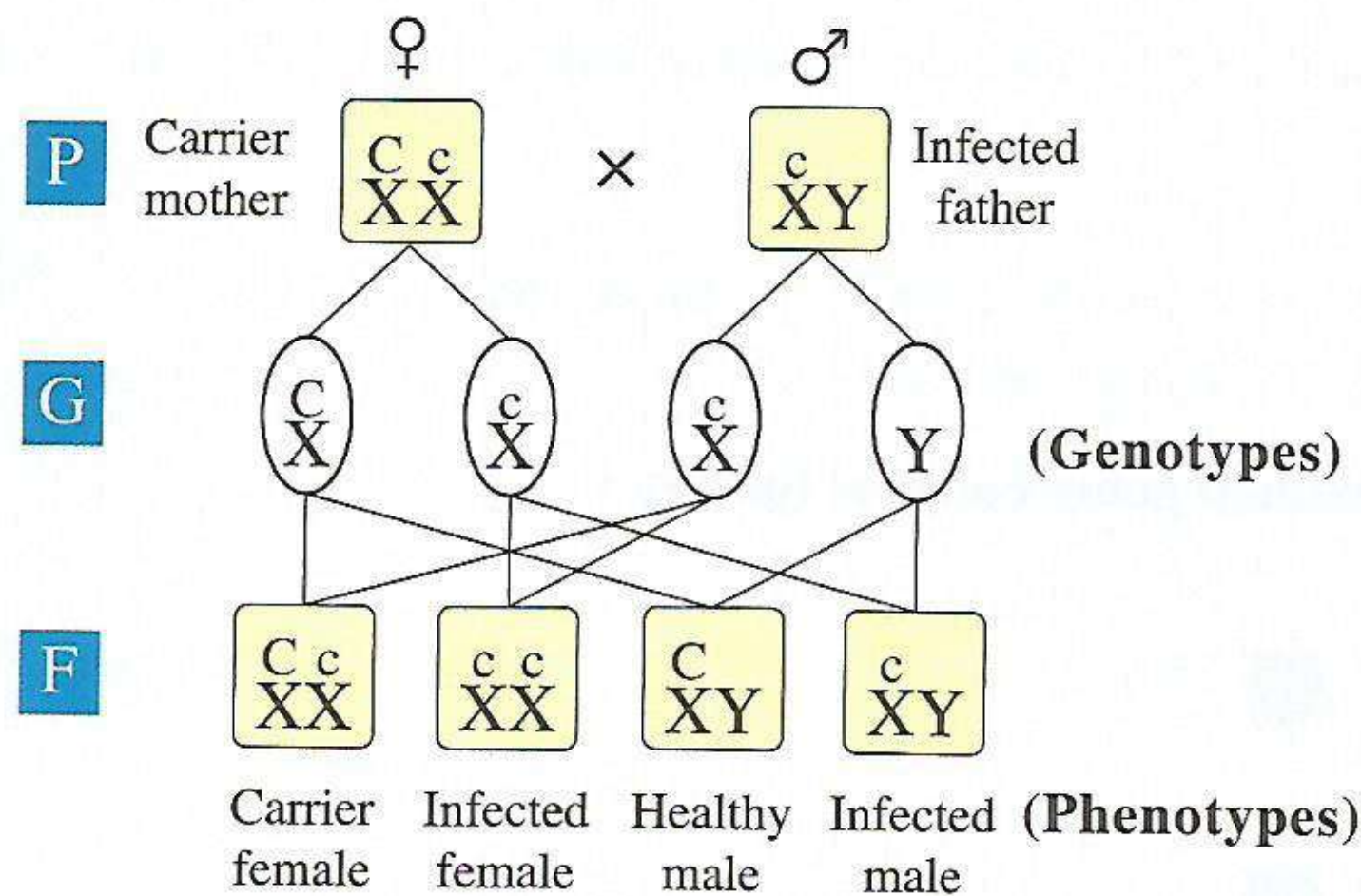


Problem

A colour-blinded man married to a woman who is a carrier to the gene of the disease.
What are the genotypes and phenotypes of the offspring ?

Solution

- We can explain this case genetically, as follows :



- We can explain the genotype of each of the human male and female in the colour blindness character, as follows :

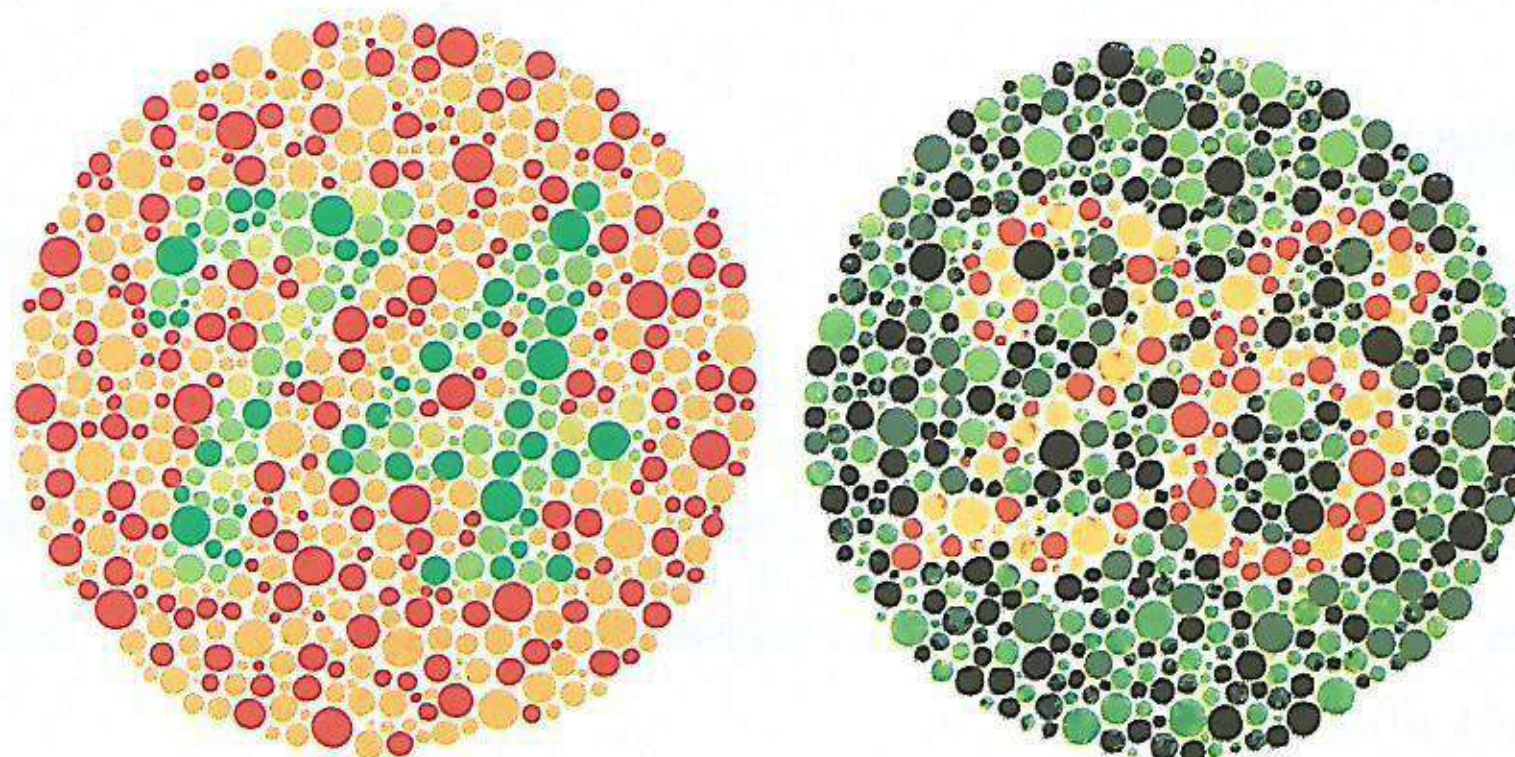
Genotype	Person case	Healthy	Carrier	Infected
Male :		$\begin{matrix} C \\ X & Y \end{matrix}$	—	$\begin{matrix} c \\ X & Y \end{matrix}$
Female :		$\begin{matrix} C & C \\ X & X \end{matrix}$	$\begin{matrix} C & c \\ X & X \end{matrix}$	$\begin{matrix} c & c \\ X & X \end{matrix}$

Test your eyes :

- Look at the two following figures :

What is the number that is present in both the first and second circles ?

Your success in reading the numbers correctly indicates that you are healthy from colour blindness.



2 Haemophilia (Blood liquidity)

Haemophilia

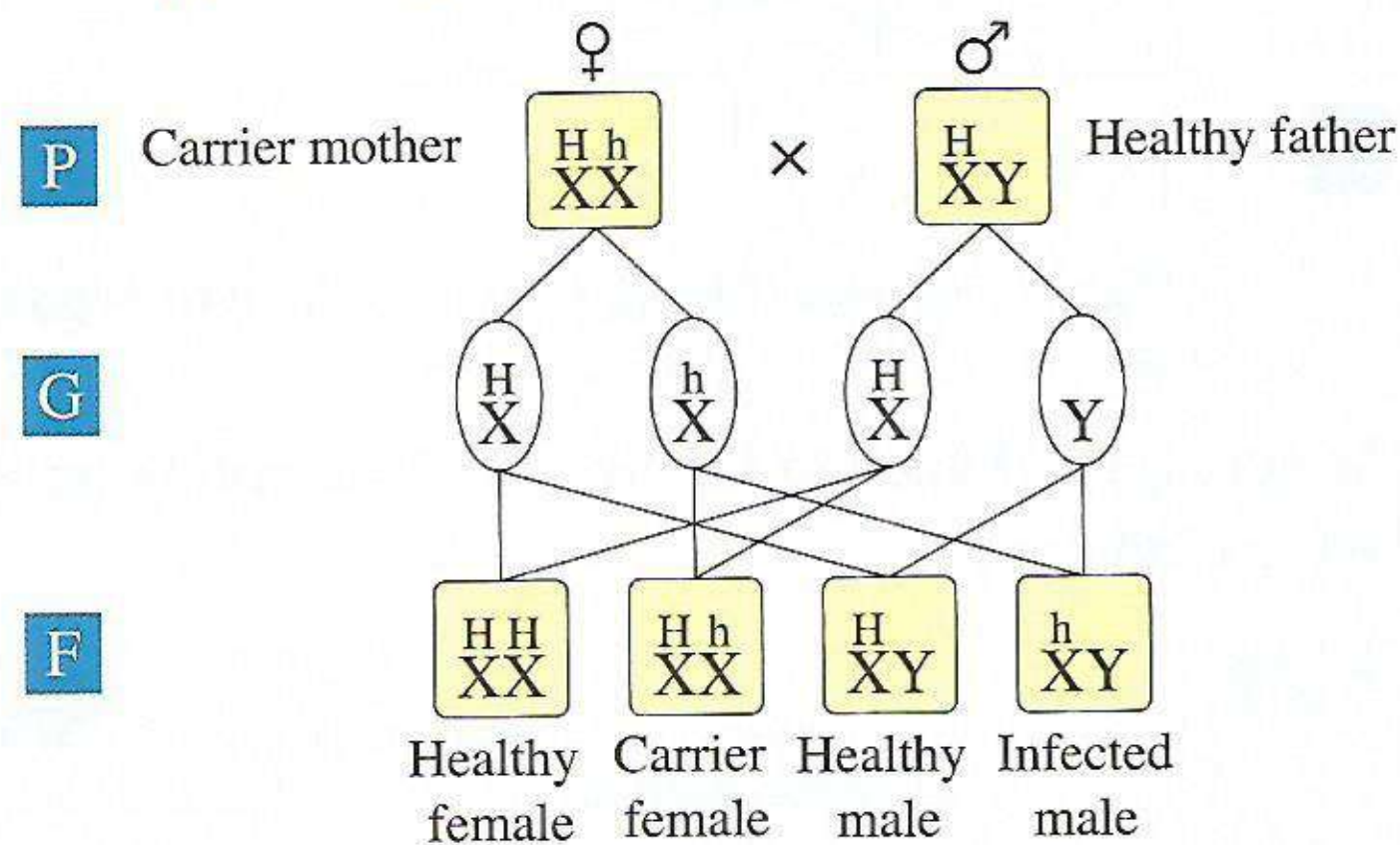
A genetic case causes blood liquidity, due to the lack of some substances that are necessary for the blood clotting.

- The case of haemophilia is caused by a **recessive gene** that is carried on the chromosome (X).
- Haemophilia disease may cause death, especially in the childhood stage.

Example

When a healthy man married to a haemophilic carrier woman, the resulted generation includes healthy and infected individuals.

- This can be explained genetically, as follows :



- We can explain the genotype of each of the human male and female in the haemophilia character, as follows :

Person case	Healthy	Carrier	Infected
Genotype			
Male :	$\frac{H}{XY}$	—	$\frac{h}{XY}$
Female :	$\frac{HH}{XX}$	$\frac{Hh}{XX}$	$\frac{hh}{XX}$

From the previous, we conclude that :

- 1 The sex-linked traits (colour blindness - haemophilia) are more common among males than females, where :
 - **In males** : they are represented by one gene only, because the chromosome (Y) doesn't carry the genes of the colour blindness and haemophilia characters.
 - **In females** : they are represented by a pair of genes, because the female cells contain a pair of sex chromosomes (XX).

- ② The male passes the trait gene to his daughters and doesn't pass it to his sons, because he passes the chromosome (Y) to males (sons) and chromosome (X) which carries the trait gene to females (daughters).
- ③ The male passes the trait gene to his grandsons through his daughters.
- ④ The mother passes the trait genes to her sons and daughters.
- ⑤ Sons continually inherit the sex-linked traits (colour blindness - haemophilia) from their mother, whereas the trait appears on daughters, when they inherit the trait gene from both their father and mother.

Enrichment information

The case of muscles atrophy is caused by a sex-linked lethal recessive gene that is carried on the chromosome (X). The infection is restricted only to males and its symptoms appear at the age of twelve, where it causes a gradual atrophy of muscles that ends by death.

② Test yourself**Answered****Choose the correct answer :**

- (1) There is a dominant gene (vitamin D-resistant rickets disease) that is present in human, it is carried on the sex chromosome (X) and causes non-response to vitamin D. So, when a male who suffers from this disease is married to a normal female :
 1. The percentage of males who suffer from this disease is
(a) 0% (b) 25% (c) 50% (d) 75%
 2. The percentage of females who suffer from this disease is
(a) 100% (b) 75% (c) 50% (d) 25%
- (2) When a male suffers from the colour blindness married to a carrier woman to the colour blindness. So :
 1. The percentage of males who suffer from this disease in the resulted generation is
(a) 0% (b) 25% (c) 50% (d) 75%
 2. The percentage of females who suffer from this disease among all the resulted females is
(a) 0% (b) 25% (c) 50% (d) 75%

Sex-influenced traits

Sex-influenced traits

They are the genetic traits that their genes are carried on autosomes not on sex chromosomes and the individual's sex acts sometimes to modify the dominance of some traits, where the action of these genes is influenced by the sex hormones that are secreted from the gonads of adult males and females.

Examples

- Genetic baldness trait in human.
- The presence of horns trait in some cattle species.
- We will study the inheritance of genetic baldness in some details :

Baldness

- It spreads among males of some families more than females, because its appearance is controlled by a **dominant gene** that is responsible for the hair falling, which is carried on an autosome and influenced by **the masculinity (male) hormones only**.
- The presence of one gene only is enough for the appearance of baldness trait in males, due to the presence of masculinity hormones, while its appearance in females requires the presence of both genes together.
- The following table illustrates that :

Genotype Sex	Pure genotype (B ⁺ B ⁺)	Hybrid genotype (B ⁺ B)	Pure genotype (BB)
Male :	Male suffers from baldness, due to : - The presence of two dominant genes. - The effect of the masculinity hormones.	Male suffers from baldness, due to : - The presence of one dominant gene. - The effect of the masculinity hormones.	Normal hair.
Female :	Female suffers from genetic hair falling, due to the presence of two dominant genes.	Normal hair, although the presence of one dominant gene, but it doesn't express itself, due to the absence of the masculinity hormones.	Normal hair.

- **Therefore**, the phenotype of the hybrid genotype (B^+B) is different in male from that in female.



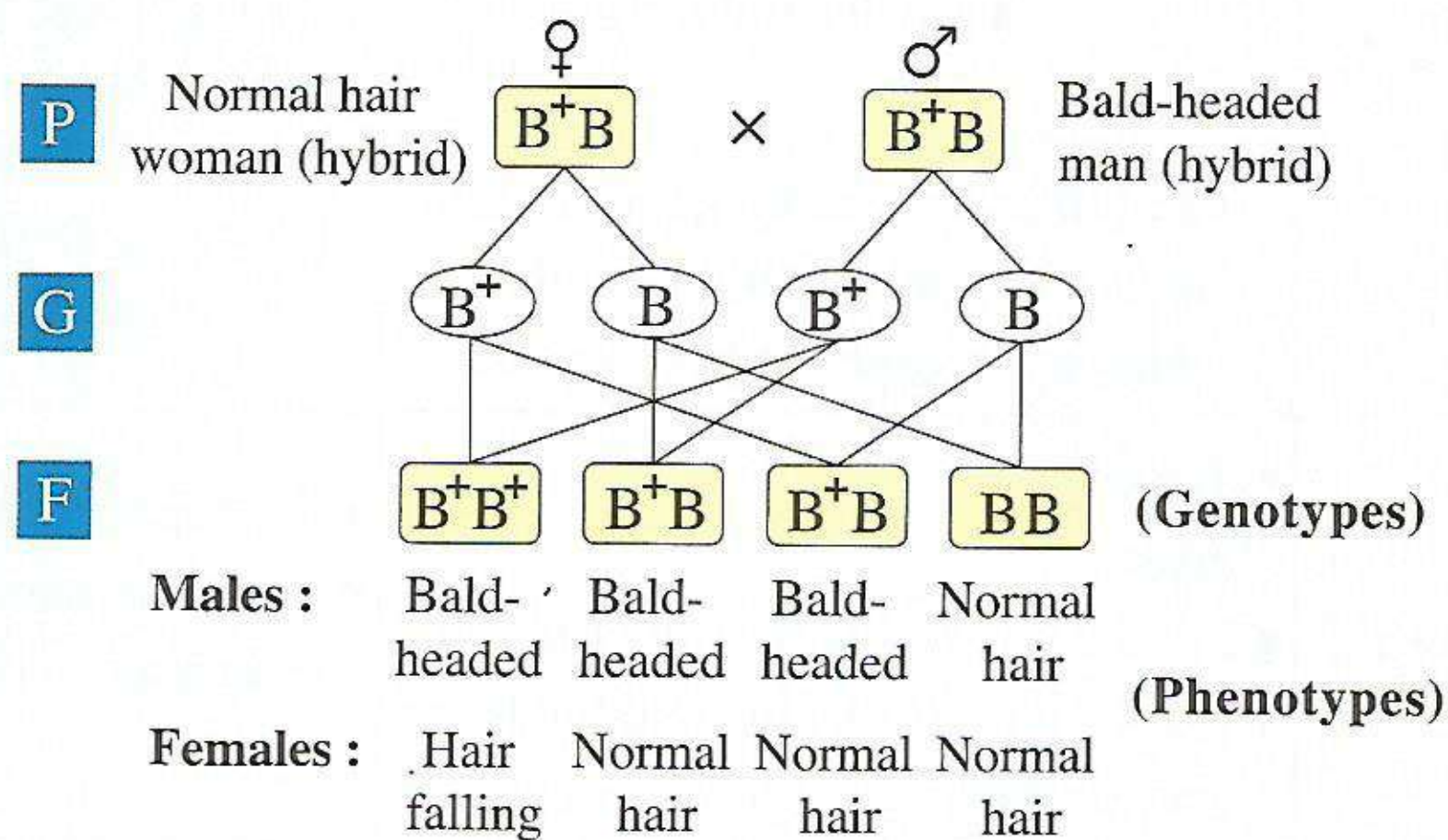
Genetic baldness in males
(B^+B^+ and B^+B)



Genetic hair falling in females
(B^+B^+)

Example

A hybrid bald-headed man (B^+B) is married to a hybrid woman who doesn't suffer from hair falling (B^+B). Explain this genetically.



3 Test yourself

Answered

Choose the correct answer :

When a bald-headed man married to a normal hair woman, both of them have symmetrical genes of this character, what is the possibility of the appearance of sons who suffer from baldness ?

- (a) 25% (b) 50% (a) 75% (d) 100%

★ From the previous, we can compare between the sex-linked traits and the sex-influenced traits, as follows :

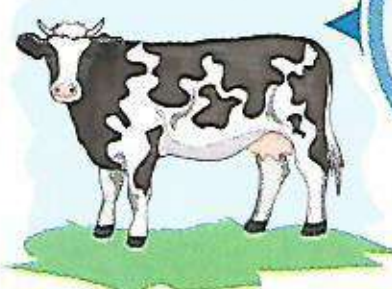
P.O.C.	Sex-linked traits	Sex-influenced traits
Location of the trait genes :	Located on sex chromosomes.	Located on autosomes.
Influence of genes by sex hormones :	It is not influenced by sex hormones.	Influenced by sex hormones.
Dominance of genes :	One of the two genes is dominant over the other (complete dominance).	The single dominant gene is influenced by the masculinity hormones only, and doesn't express itself in female, unless in case of the presence of both genes.
The hybrid individuals :	Females only.	Males and females (the phenotype of the hybrid male differs from that in female).
Inheritance of genes :	The father passes the genes to his daughters only, and the mother passes the genes to both sexes.	The two parents pass the genes to both sexes.
Examples :	<ul style="list-style-type: none"> • Eye colour character in <i>Drosophila</i> insect. • Colour blindness, haemophilia (blood liquidity), short-sightedness and muscles atrophy in human. 	<ul style="list-style-type: none"> • Baldness character in human. • The presence of horns character in some cattles species.

Sex-limited traits

Sex-limited traits

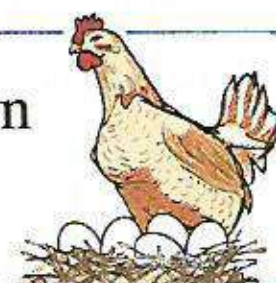
They are traits whose appearance is constricted (limited) on one sex only, due to the differences in sex hormones of each sex.

Milk production trait is limited only on females, because they have certain sex hormones that help the gene to express itself as in cows.



From the examples of sex-limited traits

Egg laying trait is limited on females only, such as birds.



The appearance of beard trait is limited on males only, and it is one of the secondary sex characters in human male.



Medical examination before marriage

- **Medical examination before marriage** is a series of medical examinations that are carried out for the people who will get married.
- **The causes of medical examination for people who will get married :**
 - ① To be sure that they are free from :
 - Infectious diseases, such as hepatitis and the disease of acquired immune deficiency (AIDS).
 - Genetic diseases, such as thalassaemia.
 - ② Giving the medical advice about the possibility of transmission of the previous diseases to the other partner or offspring in the future.
 - ③ Providing the choices or alternatives to whom will get married to help them planning for a healthy family.
- **The importance of the medical examination before marriage :**
 - ① Giving birth to healthy children.
 - ② Limiting the spreading out of genetic diseases, congenital deformities and mental retardation.
 - ③ Avoiding the financial, psychic and social loads, when caring the children who suffer from genetic diseases.

Note

The marriage of relatives and proceeding without making the medical examinations before marriage are considered from the factors of spreading the genetic diseases.

4 Test yourself

Answered

Choose the correct answer :

Which of the following agrees with the inheritance of the beard appearance in men ?

- (a) The genetic factors are the same in both sexes.
- (b) The appearance of the beard is affected by the male sex hormones.
- (c) The effect of the gene is not related to the sex.
- (d) The female sex hormones stimulate the gene activity.

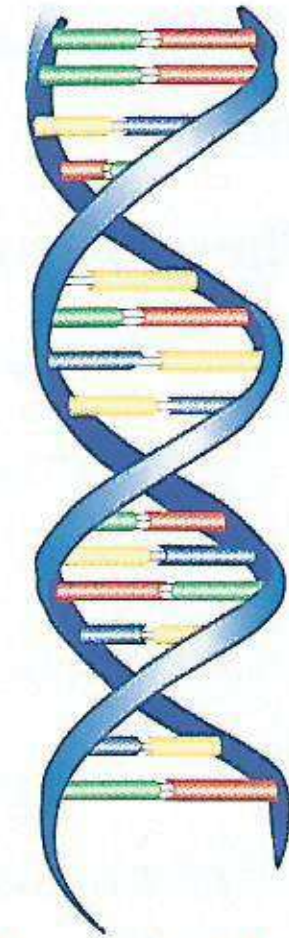
1 Genetic fingerprint (DNA fingerprint)

Discovering the genetic fingerprint :

- In 1984, Sir Alec Jeffreys at Leicester university in London published a research which shown that the genetic material (DNA) may be repeated several times inside the living organism.
- In 1985, he stated that these repetitive sequences are unique and characteristic for each individual and they are impossible to be similar in two individuals, except in cases of the identical twins only. He named them "**the human DNA fingerprint (DNA typing)**".

DNA fingerprint

- It is sequences of the genetic material (DNA) that repeat themselves several times in the living organism.
- It is a mean used to identify individuals through comparing the DNA sections (fragments).



DNA carries the code of genetic fingerprint

Uses of genetic fingerprint :

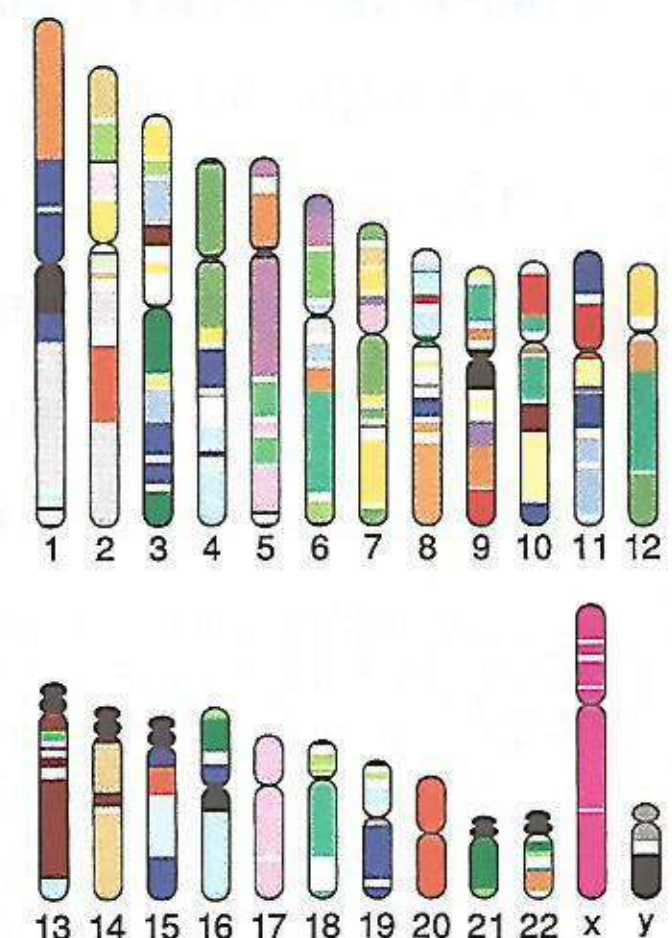
- ① **In medicine :** studying the genetic diseases and operations of tissues implantation.
- ② **In forensic medicine :**
 - Identifying the deformed carpses.
 - Tracing the missing children.
 - Judging issues of ancestries.
 - Exoneration or condemnation of people from killing and ravishment crimes.

2 Human genome

- The number of genes in each cell is estimated between 60000 : 80000 genes that are carried on 23 pairs of chromosomes. This number is called the "**human genome**" and it is responsible for the presence of enormous number of human characters.

Human genome

It is all the genes that are found in the nucleus of each somatic cell.



Chromosomes carry thousands of genes

Discovering the human genome :

- In 1953, **Watson** and **Crick** proved that the genes are carried on a double helix of the nucleic acid DNA
- In 1980, the idea of human genome appeared and the number of genes identified by scientists was about 450 genes.
- In the middle of eighties, the number of identified genes was doubled three times to reach about 1500 genes.

**Watson****Crick****Uses of the human genome :**

- 1 Identifying the genes causing the genetic diseases through drawing a good genetic map that identifies the location of genes on the chromosomes accurately.
- 2 Studying the evolution of living organisms through comparing the human genome with others of living organisms.
- 3 Breed improving through identifying the genes of diseases in the fetus before its delivery and act to improve them.
- 4 Manufacturing drugs without side effects.

- Sex-linked, Sex-influenced and Sex-limited Traits.
- Medical Examinations Before Marriage.



Interactive test

The questions signed by measure the high levels of thinking.

First

Multiple Choice Questions

- We can obtain white-eyed females in *Drosophila* insect, when
 - white-eyed male crossed with red-eyed female (pure).
 - red-eyed male crossed with red-eyed female (hybrid).
 - red-eyed male crossed with white-eyed female.
 - white-eyed male crossed with red-eyed female (hybrid).
- Which of the following can't be obtained when crossing a red-eyed male of *Drosophila* with a hybrid female ?
 - Red-eyed male.
 - White-eyed male.
 - A carrier female to the red colour gene.
 - White-eyed female.
- Which of the following illustrates the genotypes of the parents that produce the offspring shown in the opposite figure ?

- $\frac{RR}{XX} \times \frac{R}{XY}$
 - $\frac{r}{XX} \times \frac{R}{XY}$
 - $\frac{RR}{XX} \times \frac{r}{XY}$
 - $\frac{Rr}{XX} \times \frac{R}{XY}$
- A crossing occurred between *Drosophila* male and female, 25% of the offspring carried the recessive trait. So, the genotypes of the parents are
 - $\frac{Rr}{XX} \times \frac{r}{XY}$
 - $\frac{Rr}{XX} \times \frac{R}{XY}$
 - $\frac{RR}{XX} \times \frac{r}{XY}$
 - $\frac{rr}{XX} \times \frac{R}{XY}$
- Which of the following statements is applied to the colour blindness case ?
 - The infected mother passes the gene of the character to her sons not to her daughters.
 - It spreads among males more than females.
 - It spreads among females more than males.
 - The infected mother passes the gene of the character to her daughters not to her sons.
- All the following are considered a reason for a girl to inherit the colour blindness character, except
 - the mother is a carrier for one allele of the disease.
 - the mother is a carrier for two alleles of the disease.
 - the father is not a carrier for the allele of the disease.
 - the father is a carrier for the allele of the disease.

- 7 When a healthy man married to a colour-blinded woman, this disease will appear in of their offspring.
 (a) all males (b) all females (c) half males (d) half females
-
- 8 The male who suffers from the colour blindness,.....
 (a) his father suffers from the colour blindness.
 (b) his mother suffers from the colour blindness.
 (c) his mother is a carrier for the gene of the disease.
 (d) (b) or (c).
-
- 9 A normal man married to a normal woman, but her father suffers from colour blindness. So, the percentage of the infected males that are resulted from this mating is
 (a) 25% (b) 50% (c) 75% (d) 100%
-
- 10 If a woman that is heterozygous for the colour blindness disease is married to a man who can't distinguish the red and green colours. What is the percentage of the appearance of the disease among females ?.....
 (a) 25% (b) 50% (c) 75% (d) 100%
-
- 11 A healthy man whose father suffers from haemophilia married to a healthy woman, whereas this disease was not known throughout the history of her family. What are the possibilities of the appearance of this disease among the children ?
 (a) All the children are normal.
 (b) All males are infected and all females are normal.
 (c) All females are infected.
 (d) All males are normal and half the females are infected.
-
- 12 When a healthy man married to a haemophilia carrier woman, the possibility of the emergence of females suffering from this disease is
 (a) 0% (b) 25% (c) 50% (d) 100%
-
- 13 Which of the following crossings may emerge a healthy child not suffering from haemophilia disease ?
 (a) A haemophilic mother and a normal father.
 (b) Haemophilic mother and father together.
 (c) A carrier mother to haemophilia disease and a normal father.
 (d) Normal mother and father together.

14 A carrier woman to haemophilia disease claimed the parenthood of a man to her daughter who suffers from haemophilia disease, knowing that this man is healthy. So, this indicates that

- (a) this man is the father of this child with 100%
- (b) this man is the father of this child with 50%
- (c) this man is the father of this child with 75%
- (d) it is impossible for the man to be the father of this child.

15 When a healthy man married to a haemophilic woman, which of the following must be happened in the resulted offspring ?

- (a) All sons are healthy.
- (b) The son has the same phenotype of his father.
- (c) Haemophilia doesn't appear on all daughters.
- (d) The daughter has the same genotype of her mother.

16 All the following individuals can inherit the gene of the colour blindness from the infected father, except

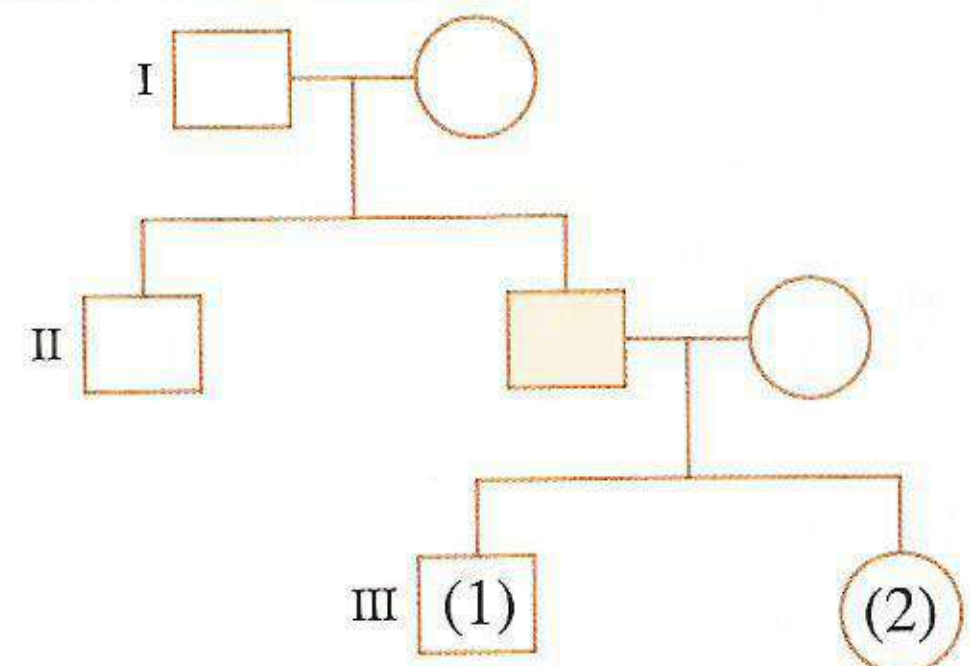
- (a) granddaughters.
- (b) grandsons.
- (c) daughters.
- (d) sons.

17 If a daughter suffers from haemophilia disease, this is because the

[Choose two answers]

- (a) mother is normal and the father is infected.
- (b) mother is infected and the father is normal.
- (c) mother is a carrier for the gene of the disease and the father is normal.
- (d) mother is a carrier for the gene of the disease and the father is infected.
- (e) mother and father are infected.

18 The opposite diagram represents the inheritance of short-sightedness trait in a certain family, study it, then answer (knowing that the shaded part indicates a disease case) :



(1) The presence of a son suffering from short-sightedness, although his parents don't suffer from this disease, this is because

- (a) the grandfather related to father suffers from short-sightedness.
- (b) the mother's father suffers from short-sightedness.
- (c) the grandparents related to father suffer from short-sightedness.
- (d) the father's mother suffers from short-sightedness.

(2) The genotypes of children (1) and (2) are respectively.

	(1)	(2)
(a)	$\overset{s}{X}Y$	$\overset{s}{X}\overset{s}{X}$
(b)	$\overset{S}{X}Y$	$\overset{S}{X}\overset{S}{X}$
(c)	$\overset{s}{X}Y$	$\overset{S}{X}\overset{s}{X}$
(d)	$\overset{S}{X}Y$	$\overset{S}{X}\overset{s}{X}$

19 Huda who is a student in the first secondary year has 3 brothers suffering from short-sightedness disease, but she doesn't suffer from it. What are the genotypes for the short-sightedness character in parents ? [Choose two answers]

- (a) $\overset{A}{X}\overset{A}{X} \times \overset{a}{X}Y$ (b) $\overset{A}{X}\overset{a}{X} \times \overset{A}{X}Y$ (c) $\overset{a}{X}\overset{a}{X} \times \overset{a}{X}Y$
 (d) $\overset{a}{X}\overset{a}{X} \times \overset{A}{X}Y$ (e) $\overset{A}{X}\overset{a}{X} \times \overset{a}{X}Y$

20 In which of the following cases the phenotype expresses the genotype ?

- (a) A woman doesn't suffer from haemophilia.
 (b) A white-eyed *Drosophila* male insect.
 (c) A carrier woman for the short-sightedness gene.
 (d) A red-eyed *Drosophila* female insect.

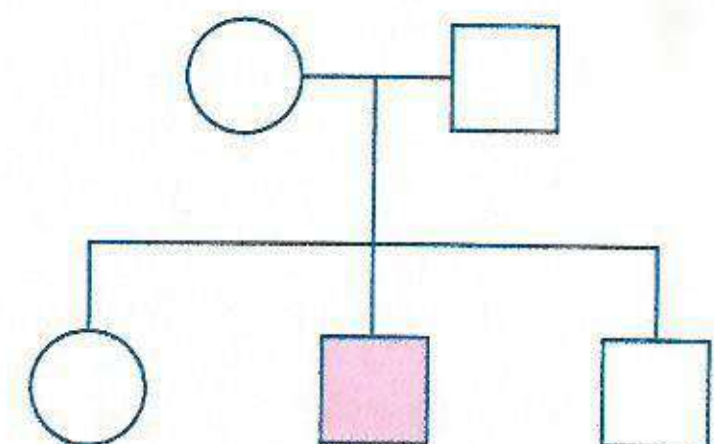
21 Alport syndrome which is linked with chromosome (X) takes place due to the gene mutation in the collagen protein that is required for building the two kidneys, which causes the destroy of blood vessels in the kidneys. In the light of the previous, which statement is correct according to the inheritance of this syndrome ?

- (a) It is inherited from the father to his sons only.
 (b) It is inherited from the mother to her sons and daughters.
 (c) It is inherited from the mother to her daughters only.
 (d) It is represented by two genes in sons only.

22 The opposite diagram represents a genetic map for the inheritance of the short-sightedness disease in a family, if you know that :

- The gene of this trait is symbolized by (a).
- The males are symbolized by squares.
- The females are symbolized by circles.
- The infected person is symbolized by the shaded shape.

The genotypes for this trait in the mother and the father are

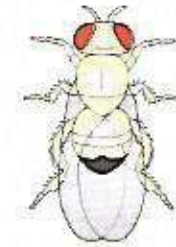


[Choose two answers]

- (a) $\overset{A}{X}\overset{A}{X}$ (b) $\overset{A}{X}\overset{a}{X}$ (c) $\overset{a}{X}\overset{a}{X}$
 (d) $\overset{A}{X}Y$ (e) $\overset{a}{X}Y$

- 23 When a bald-headed man (pure) married to a normal hair woman (hybrid), the possibility of the appearance of a daughter who doesn't suffer from hair falling is
 (a) 25% (b) 50% (c) 75% (d) 100%
-
- 24 ✎ Mona and her brother Ahmed inherited one of the dominant genes from their father, the effect of the gene appeared on Ahmed and didn't appear on Mona, which of the following is correct about this gene ?
 (a) It is affected by the male sex hormones. (b) It is carried on chromosome (Y).
 (c) It is affected by the female sex hormones. (d) It is carried on chromosome (X).
-
- 25 Which of the following statements doesn't agree with the inheritance of the baldness trait in human ?
 (a) The trait doesn't appear in male children.
 (b) The trait is common in males and rare in females.
 (c) The presence of one gene is enough for the trait to appear in females.
 (d) The presence of the baldness gene in a single form is active in males and inactive in females.
-
- 26 The baldness trait shares the colour blindness trait in that
 (a) the genes of the two traits are carried on the autosomes.
 (b) the genes of the two traits are carried on the sex chromosomes.
 (c) both of them spread among males more than females.
 (d) both of them influenced by the male sex hormones.
-
- 27 If both the mother and father have normal hair and their son suffers from baldness. So, the possibility of having a female with normal hair is
 (a) 25% (b) 50% (c) 75% (d) 100%
-
- 28 The trait which its appearance is affected by the sex hormones in animals is
 (a) colour blindness. (b) haemophilia. (c) baldness. (d) the horns trait.
-
- 29 When a bald-headed man married to a normal hair woman, whereas both of them are hybrid, what is the ratio of the emergence of baldness in the offspring (males only) ?
 (a) $\frac{1}{4}$ (b) $\frac{2}{4}$ (c) $\frac{3}{4}$ (d) $\frac{4}{4}$
-
- 30 Which of the following agrees with the inheritance of the milk production trait ?.....
 (a) The effect of the gene is not related to the sex.
 (b) The male sex hormones activate the gene.
 (c) The genetic factors are the same in both sexes.
 (d) The gene of milk production is affected by the female sex hormones.

Second Miscellaneous Questions

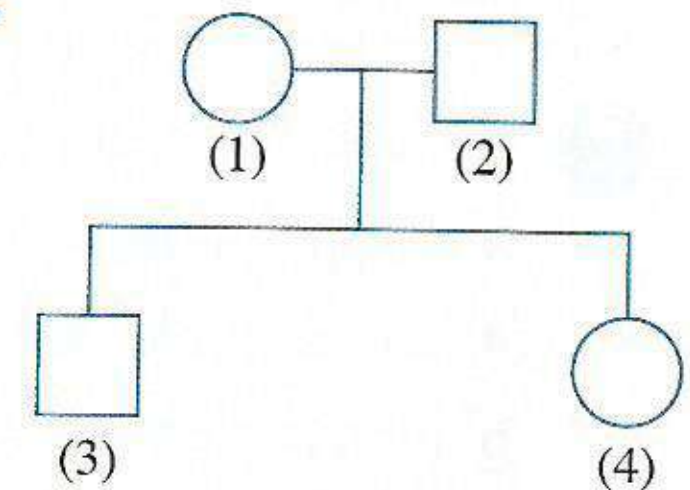


- 1 Give reason for : the appearance of the white-coloured eyes in the *Drosophila* females is rare.
- 2 Compare between : sex chromosome (X) and sex chromosome (Y) in human.
- 3 The opposite figure illustrates the male of *Drosophila* insect, write its genotype according to the eye colour character. "Knowing that the recessive gene is symbolized by (a)".

- 4 ✎ The following diagram represents a genetic map for mating a white-eyed female of *Drosophila* insect with a red-eyed male, if you know that :

- The males are symbolized by squares.
- The females are symbolized by circles.

If the shaded shapes symbolize the individuals that carry the recessive trait. What are the numbers of the individuals that will be shaded ? With writing their genotypes.



- 5 Give reason for : the eye colour trait in the *Drosophila* male insect is always pure.
- 6 Give reason for : the colour blindness disease is more common among males than females.
- 7 The following table illustrates the inheritance of a sex-linked trait in human :

♀ \ ♂	(A)	(Y)
C X	A female carries the gene of the disease.	A normal male.
c X	An infected female.	An infected male.

(a) Deduce the genotype of gamete (A).

(b) Why are there no males carrying the gene of the disease ?

- 8 Give reason for : the colour-blinded father passes the disease to his grandsons through his daughters.
- 9 ✎ Mariam is a student in the first primary grade, a teacher gave her an exam sheet (connect the colour of the traffic light with the suitable word), she can't answer the exam, because she suffers from a genetic disease, deduce the genetic case of Mariam's father in the light of your study.
- 10 ✎ If you know that a girl has a brother who suffers from the colour blindness and her mother suffers from the same disease, but her father is healthy. This girl married to a healthy man, what is the possibility of the appearance of this disease among her sons ?
- 11 Give reason for : the baldness is more common among men of some families than women.
- 12 The causes of the appearance of beard and early baldness are similar in men. Explain this.

Genetic Inheritance and Genetic Diseases



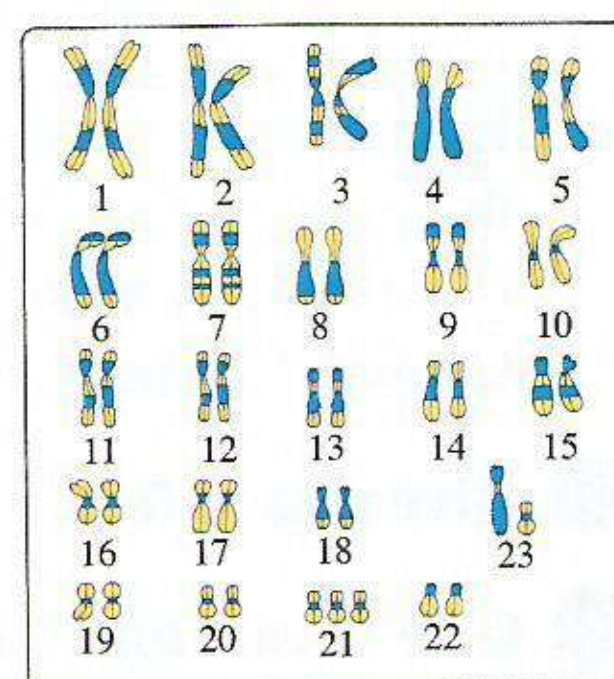
Choose the correct answer (1 : 10) :

- 1 When a healthy man married to a woman who suffers from the colour blindness, the percentage of the females suffering from this disease is

(a) 75% (b) 50%
(c) 25% (d) 0%

- 2 The opposite figure represents the karyotype of a somatic cell in

(a) a male with Down's syndrome.
(b) a male with Klinefelter's syndrome.
(c) a female with Down's syndrome.
(d) a female with Turner's syndrome.



- 3 A man suffers from haemophilia married to a normal woman and they gave birth to a daughter who suffers from this disease. So, the genotype of the parents is

(a) $\frac{Hh}{XX} \times \frac{H}{XY}$ (b) $\frac{HH}{XX} \times \frac{h}{XY}$
(c) $\frac{Hh}{XX} \times \frac{h}{XY}$ (d) $\frac{hh}{XX} \times \frac{h}{XY}$

- 4 A male with Klinefelter's syndrome differs from a male with Down's syndrome in all of the following, except

(a) the number of autosomes.
(b) the number of sex chromosomes.
(c) the hereditary traits.
(d) the number of chromosomes in the somatic cell.

- 5 If a daughter suffers from haemophilia, it is possible that

(a) the mother is infected and the father is healthy.
(b) the mother is healthy and the father is infected.
(c) the mother carries the gene of the disease and the father is healthy.
(d) the mother carries the gene of the disease and the father is infected.

- 6 If we suppose theoretically that Turner's syndrome and Down's syndrome are gathered in one person. The genotype of this person is
- (a) $44 + X0$ (b) $45 + XX$
(c) $44 + XX$ (d) $45 + X0$
- 7 When a man suffers from haemophilia married to a healthy woman, the percentage of the emergence of males suffering from this disease is
- (a) 75% (b) 50%
(c) 25% (d) 0%
- 8 The genotype of a person with Klinefelter's syndrome and suffers from the colour blindness is
- (a) $\overset{C}{X}\overset{c}{X}Y$ (b) $\overset{c}{X}\overset{c}{X}Y$
(c) $\overset{C}{X}\overset{C}{X}Y$ (d) $\overset{c}{X}Y$
- 9 The percentage of gametes that carry the genes of the colour blindness and baldness together in this genotype ($B^+B\overset{c}{X}Y$) is
- (a) 75% (b) 50%
(c) 25% (d) 0%
- 10 A man married to a woman, each one of them doesn't suffer from the colour blindness and this case appears in some children. What are the correct ratios to inherit this case ?
- (a) Half the males are infected and all females are normal.
(b) All the males are infected and all females are normal.
(c) Half the males are infected and all females are infected.
(d) All the males are healthy and half the females are infected.

Answer the following questions (11 : 17) :

- 11 Illustrate a similarity and a difference between :

	Colour blindness case	Baldness case
Similarity :		
Difference :		

12 From the following table, deduce the genotypes and phenotypes :

<div>♂</div> <div>♀</div>	22 + X	22 + XX	22 + 0
22 + X	44 + XX Healthy female	44 + XXX Polyploidy	(1)
22 + Y	(2)	(3)	
23 + X	(4)		
23 + Y	(5)		

13 When fertilizing an ovum that doesn't carry the colour blindness gene with a sperm carrying the colour blindness gene :

(a) Is the embryo male or female ? And why ?

(b) Is the embryo normal or infected ? And why ?

14 The abnormal behavior of sex chromosomes during gametes formation by meiosis causes the appearance of abnormal cases. Explain that with two examples.

The following table illustrates the gametes combination, where symbol (h) represents the haemophilia gene :

♂ \ ♀	$\frac{h}{X}$	Y
$\frac{H}{X}$	(1)	(2)
$\frac{h}{X}$	(3)	(4)

15 Record the results of gametes combination in the table.

16 Record the case of everybody in the table.

17 Write the genotypes and phenotypes of the parents.

UNIT

4

Classification of Living Organisms

Chapter 1 Principles of Living Organisms Classification.

➡ Model Exam on Chapter 1

Chapter 2 Modern Classification of Living Organisms.

Lesson One : • Kingdom Monera.

• Kingdom Protista.

Lesson Two : • Kingdom Fungi.

• Kingdom Plantae.

➡ Model Exam on Chapter 2

Chapter 3 Kingdom Animalia.

Lesson One : Kingdom Animalia.

Lesson Two : Continue : Kingdom Animalia (Phylum Chordata).

➡ Model Exam on Chapter 3



Objectives of the unit

By the end of this unit, the student should be able to :

- Define what is meant by species.
- Describe the method of binomial nomenclature of living organisms and give examples.
- Explain some attempts of classifying the living organisms.
- Design dichotomous keys.
- Explain the modern classification system.
- Explain the featured characteristics of the five kingdoms, phyla and classes.
- Give examples for kingdoms, phyla and classes.
- Classify some living organisms according to the modern classification system.
- Appreciate the grandeur of Allah in creating the different types of living organisms.
- Appreciate the scientists efforts in classifying the living organisms and identifying them.
- Follow the scientific method in solving problems.
- Form a positive trend toward the protection of biodiversity.



CHAPTER 1

Principles of Living Organisms Classification

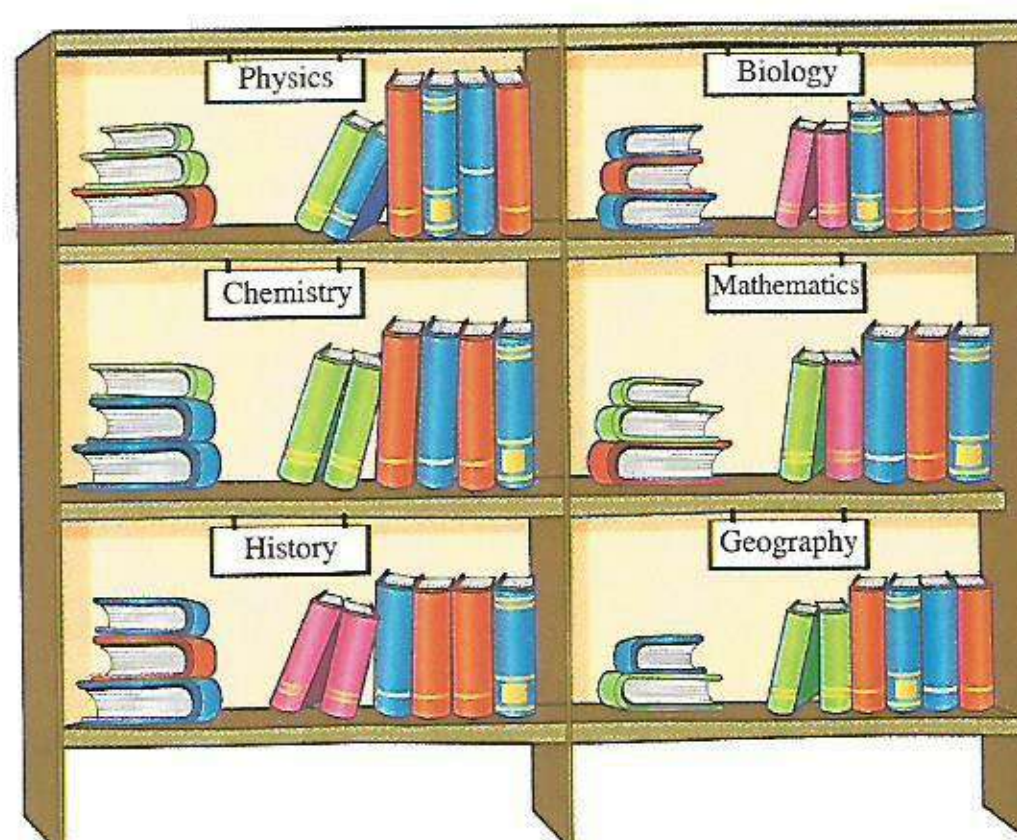
- No one knows how many several kinds of living organisms are found on the Earth's surface. In spite of human success in describing and naming about 1.4 million kinds of these types till now, biologists believe that this number doesn't represent more than 10% only of the living organisms that are present on the Earth's surface, as there are millions types of insects, small animals and plants that live in deep oceans and they are not discovered yet till now.

★ You previously knew that :

- The cell is the building and functional unit of the living organism.
- Living organisms may be unicellular or multicellular.
- Although the similarity of all living organisms in their building and functional unit (cell), as well as in the features of life, such as (nutrition, excretion, respiration, reproduction, movement, sensation and growth), also they differ from each other in many other characteristics, such as : shape, structure, mode of living, mode of nutrition and method of reproduction.
- Due to the enormous diversity in living organisms, the need for **classification process** was appeared, where biologists classify the living organisms into groups, according to their common characteristics to facilitate their study.

Classification

It is the arrangement of living organisms in groups, according to the similarities and the differences among them to facilitate their studying and identification



Arranging books in groups illustrates the concept of classification

Taxonomy

It is the science that concerns with the classification of living organisms in groups on scientific bases.

• Importance of classification :

- ① It facilitates studying and identifying the living organisms.
 - ② It facilitates identifying the new organisms and adding them to their similar groups.
 - ③ It benefits many other fields of science.
- The **modern classification system** depends on the definition of the **species** as a scientific and basic principle in classifying the living organisms.



EKB

Species

It is a group of individuals that have similar morphological characteristics (external shape), can mate with each other and produce fertile offsprings that are similar to them.

- There are individuals are not given the term "species", because they are sterile (infertile) individuals, unable to mate with each other and produce a new generation of the same species, **such as** :

① Tigon

- It is produced from the mating of a female lion with a male tiger (two different species).
- It is sterile, unable to mate, reproduce and produce a new generation of the same species.



② Mule

- It is produced from the mating of a female horse with a male donkey (two different species).
- It is sterile, unable to mate, reproduce and produce a new generation of the same species.



Enrichment information

- * The name (Tigon) is composed of two syllables from the parents names, the first half from the word (Tiger) and the second one from the word (Lion).
- * There are many living organisms which are produced from the mating of two different species, such as :
 - **Leopon** : is produced from the mating of a male leopard with a female lion.
 - **Cama** : is produced from the mating of a male camel with a female lama.
 - **Wholphin** : is produced from the mating of a male whale with a female dolphin.

1 Test yourself

The opposite figure represents a crossing of two *Antirrhinum* plants (A) and (B), study it, then illustrate :

Do the plants (A), (B) and (C) belong to the same species ?

Explain your answer, depending on the modern classification system that you have studied.

.....

.....

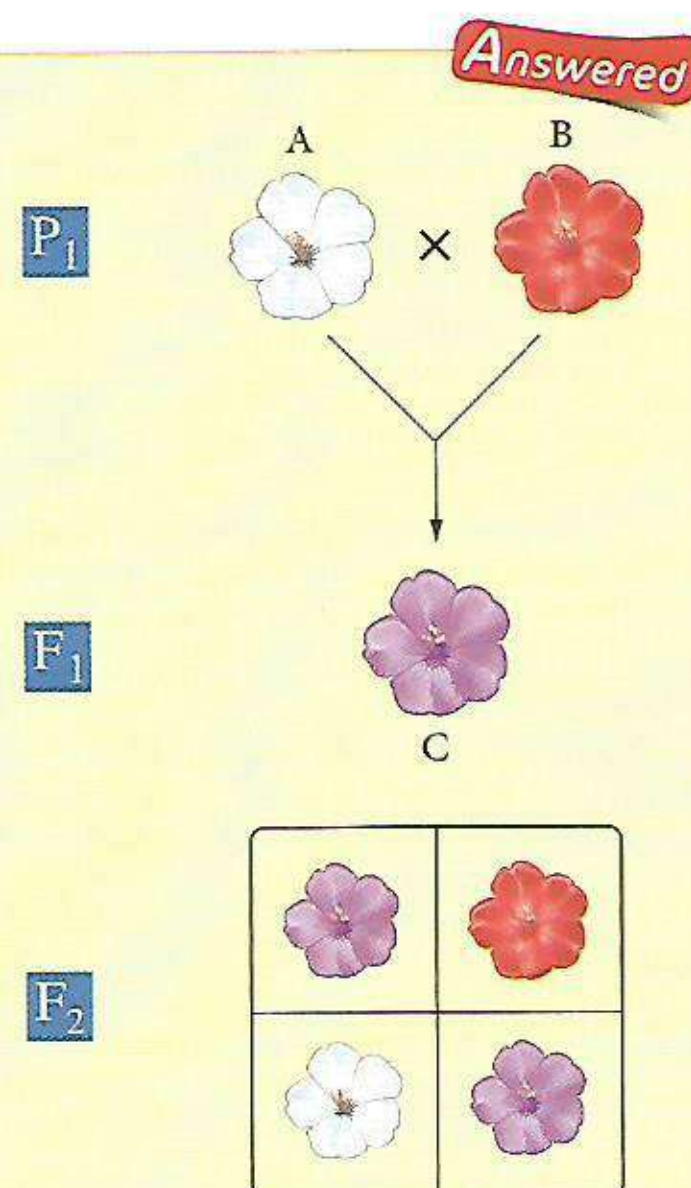
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Naming of living organisms

- A need is appeared among the scientists to name the living organisms with unified scientific names, as the same organism has many names that differ in various Earth's regions and environments and these names are known as "**common names**". To overcome this problem, the scientist **Carolus Linnaeus** developed a system for naming the organisms and gave it the name of "**Binomial Nomenclature System**".



Carolus Linnaeus

- **Conditions of writing the scientific names of living organisms in the binomial nomenclature system :**

- 1 The name is written in Latin language.
- 2 The name is written with italic letters or underlined for distinguishing it from the others.

Enrichment information

The Latin language was chosen as a scientific language, because its words have brief meanings and it is an old language that is not spoken by anyone now. This protects it from any change or modification.

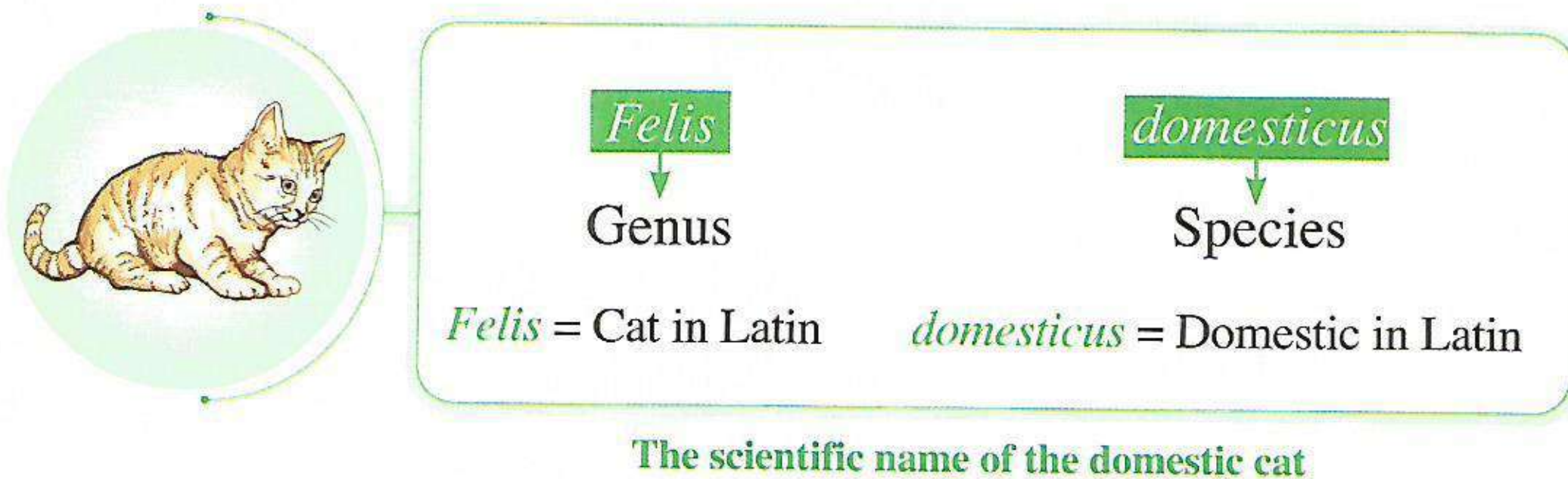
3 Each living organism in the binomial nomenclature system is given a "binomial name", where :

- The 1st name represents the **genus** and begins with a capital letter.
- The 2nd name represents the **species** and begins with a small letter.

Example

The scientific name of the cat is "*Felis domesticus*" or Felis domesticus, where :

- *Felis* represents the genus of the cat.
- *domesticus* represents the species of the cat.



2 Test yourself

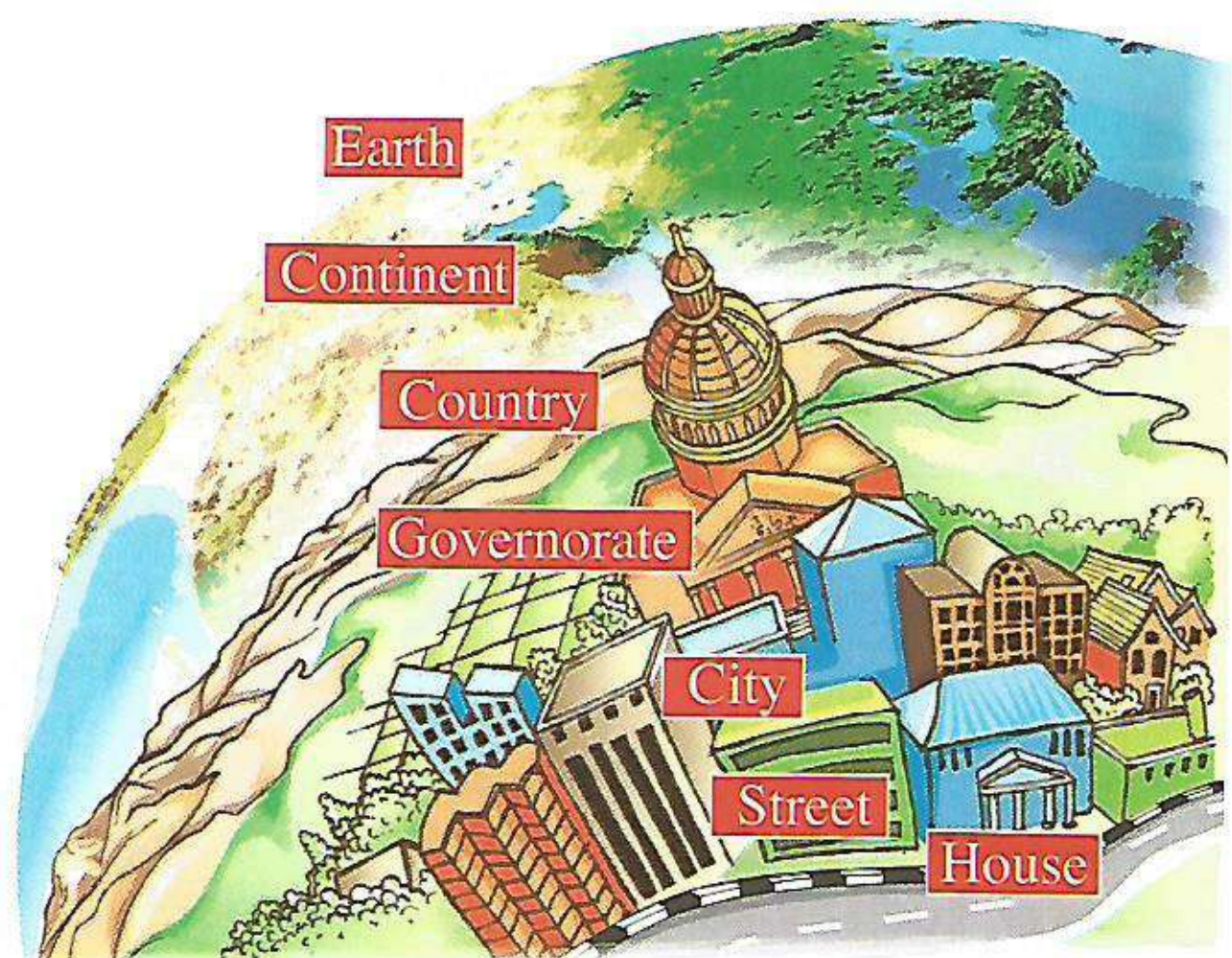
Answered

Choose the correct answer :

- The scientific name of chimpanzee is
 - pan troglodytes.
 - PAN Troglodytes.
 - Pan troglodytes.
 - Pan Troglodytes.
- If you know that the species name of Bolti is nilotica. So, the scientific name of this fish is
 - Tilapia nilotica.
 - Tilapia Nilotica.
 - Nilotica tilapia.
 - nilotica tilapia.

Taxonomic hierarchy

- There are seven levels (or groups) for classifying the living organisms. Each group comprises less number of organisms that have more similar characteristics than the group preceding it, as shown in the following figure :



1 Kingdom

- It is the highest level in the taxonomic hierarchy of the living organisms.
- It includes a number of phyla.

2 Phylum

- It is a taxonomic level that represents the largest group of the kingdom.
- It includes a number of classes.

3 Class

It includes a number of orders.

4 Order

It includes a number of families.

5 Family

It includes a number of genera.

6 Genus

It includes a number of species.

7 Species

It includes an interbreeding population of organisms that can produce healthy and fertile offspring of the same species.

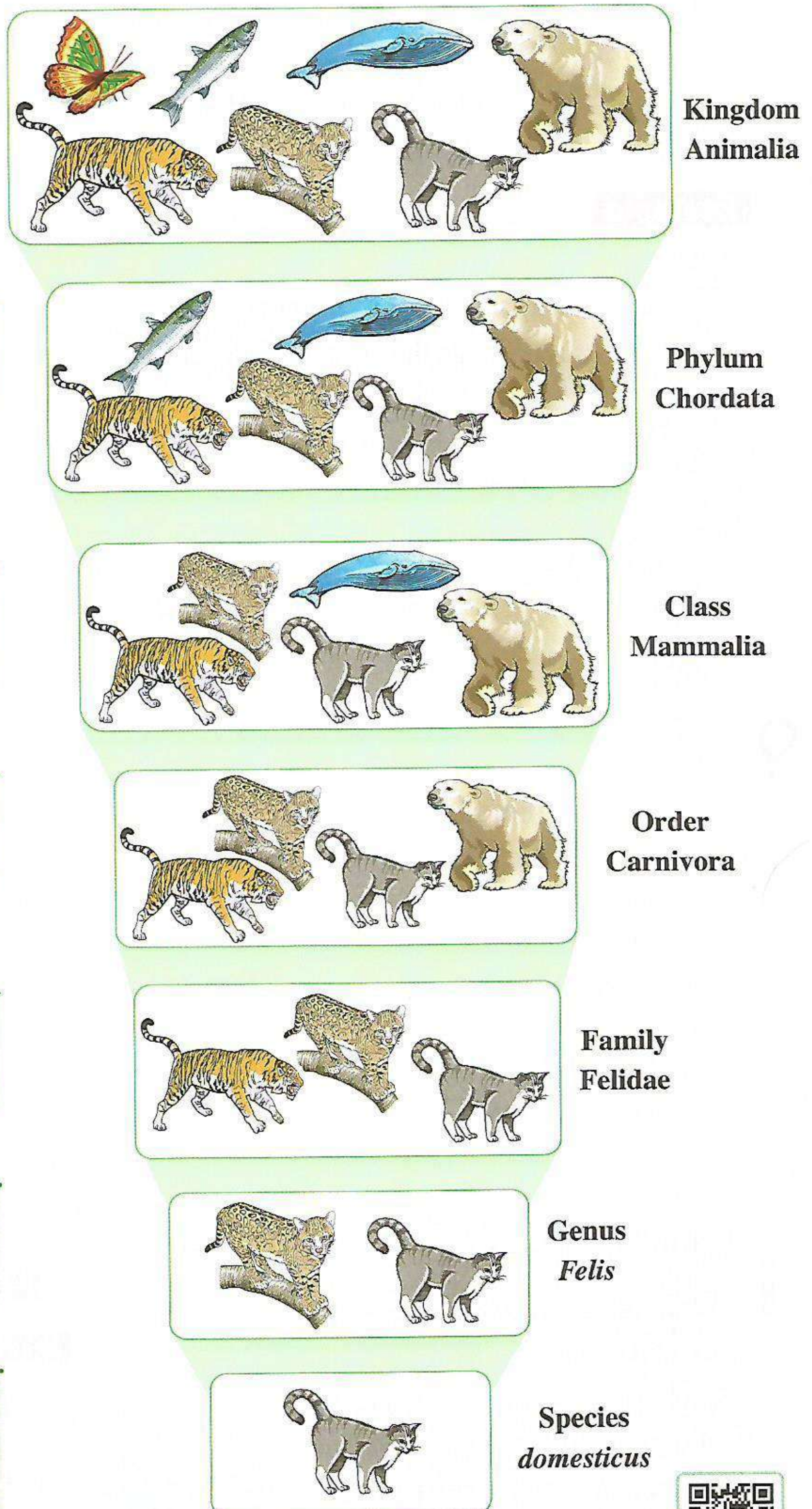


Figure illustrates the classification position of the domestic cat



Note

There are other groups that intermediate each two successive groups of the previous groups, such as **subphylum** and **subclass**.

3 Test yourself

Answered

Determine : the taxonomic relationship between (Felidae) and (Carnivora).

.....

.....

Dichotomous key

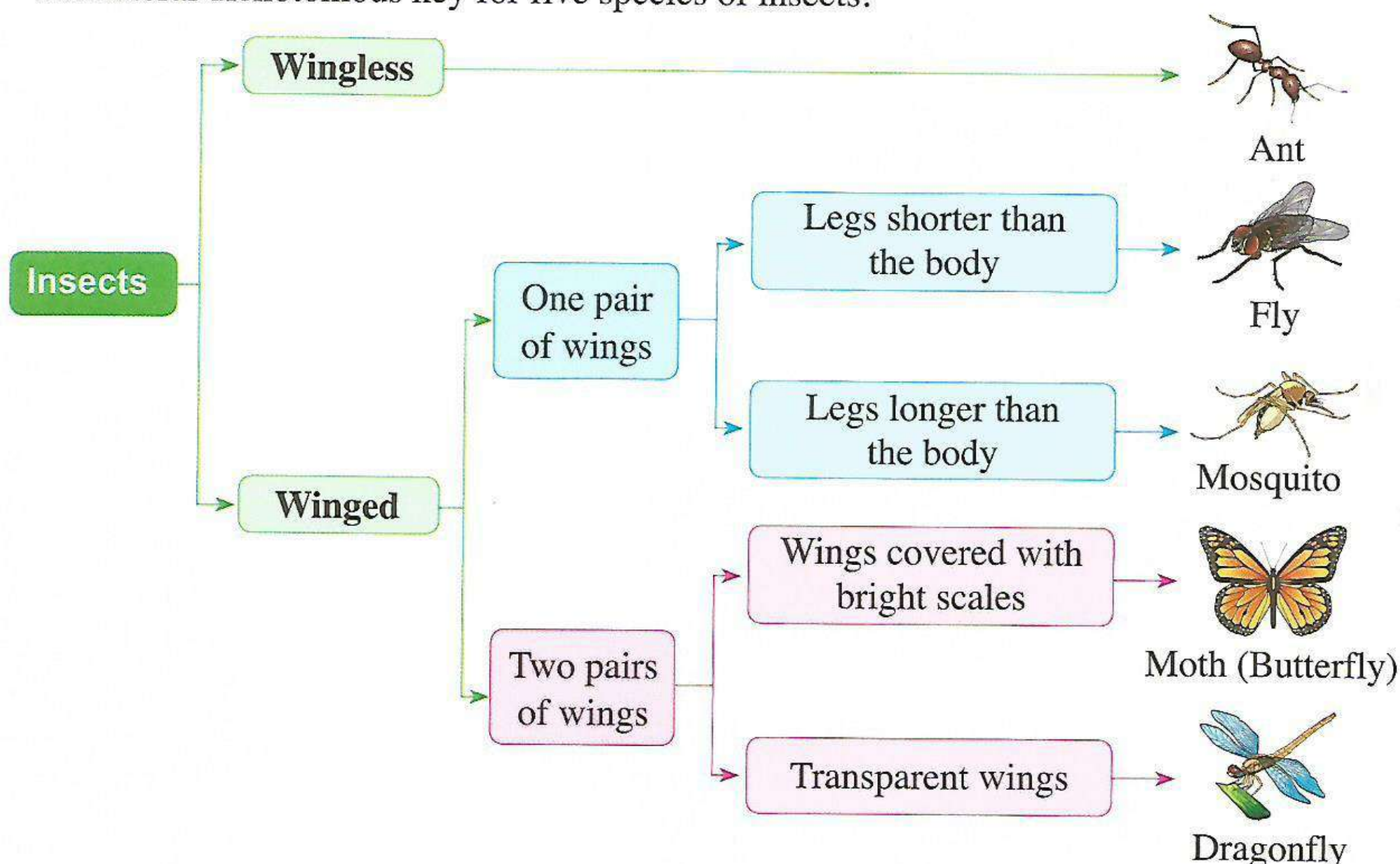
Dichotomous key

It is a series of descriptions (characteristics) that are ordered in pairs and lead the user to the identification of a living organism that is unknown to him.

- **Importance :** Biologists usually use the dichotomous key to help them in identifying the unknown living organisms.
- **Way of its designing :**
 - 1 It starts with broad features, then it gets more specific and private whenever we proceed through the levels of dichotomous key.
 - 2 Through each step, you can choose one of the two descriptions, according to the characteristics of the living organism.
 - 3 At the end, you will reach a description that leads you to the organism's name or the group to which it belongs.

Example

A bilateral dichotomous key for five species of insects.

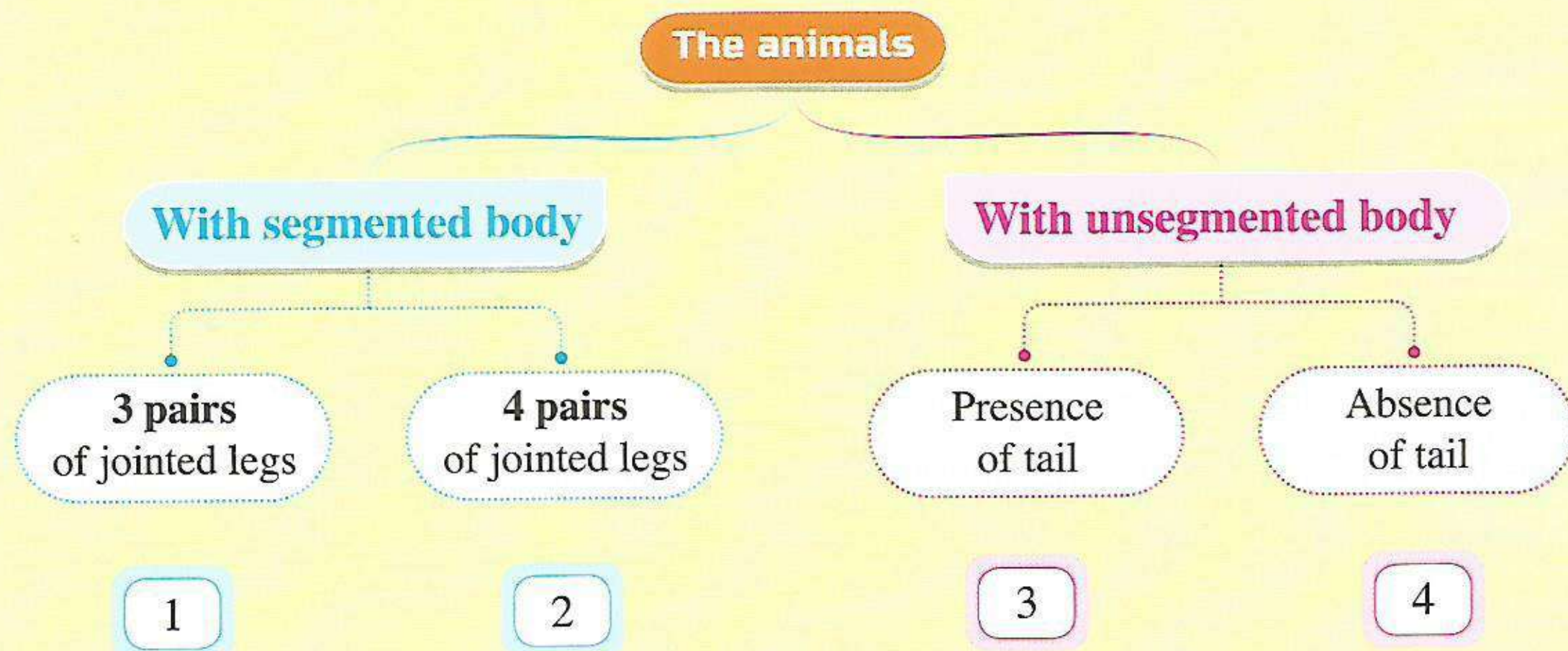


4 Test yourself

Answered

Choose the correct answer :

Depending on the following dichotomous key :



The opposite animal is classified from group no.


- (a) (1). (b) (2).
 (c) (3). (d) (4).



Principles of Living Organisms Classification




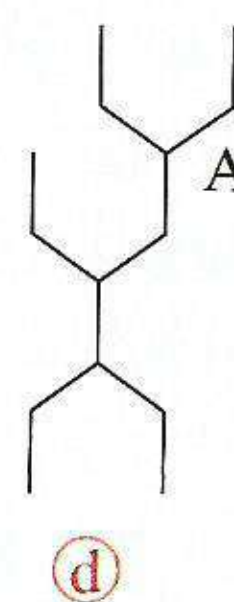
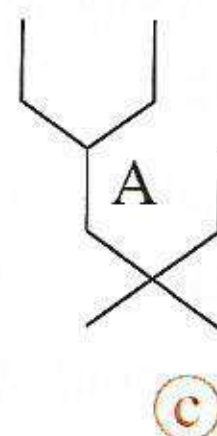
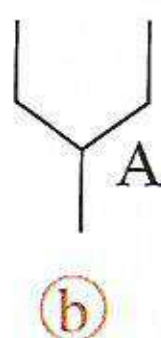
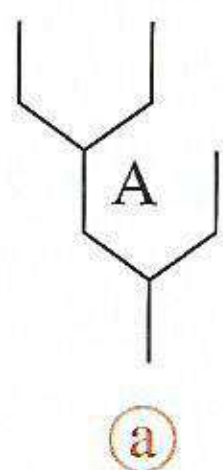
Interactive test

The questions signed by  measure the high levels of thinking.

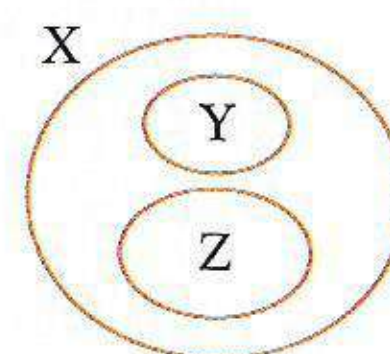
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Multiple Choice Questions

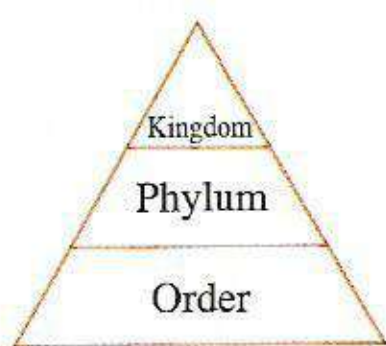
- 1 All the following are from the common life features among living organisms, except the [Choose two answers]
 - (a) respiration.
 - (b) mode of nutrition.
 - (c) excretion.
 - (d) reproduction.
 - (e) mode of living.
- 2 If you know that wholphin is produced from the mating of a male whale with a female dolphin. So, it is expected that
 - (a) it doesn't similar to its parents.
 - (b) it doesn't be able to reproduce.
 - (c) it gives fertile offsprings when reproducing.
 - (d) it is able to reproduce.
- 3 The presence of living organisms like tigon and mule leads to an increase in the number of
 - (a) individuals.
 - (b) genera.
 - (c) species.
 - (d) phyla.
- 4  If the result of the mating of a female horse with a male donkey is (A). So, the figure that represents this mating is



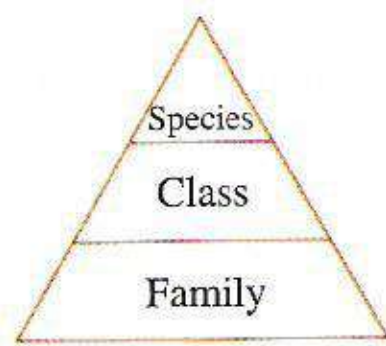
- 5 In the opposite figure, if you know that (Y) and (Z) are two different species. So, it is concluded that
 - (a) (Y) and (Z) are morphologically similar.
 - (b) the mating of (Y) and (Z) produces individuals belong to (X).
 - (c) all (X) individuals belong to different species from (Y) and (Z).
 - (d) the mating of (Y) and (Z) produces fertile offsprings.



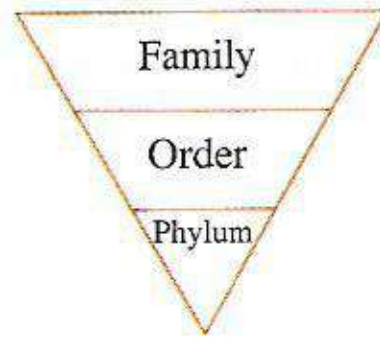
- 6 Which one of the following figures shows the correct arrangement of living organisms from the most to the least having common morphological characteristics ?



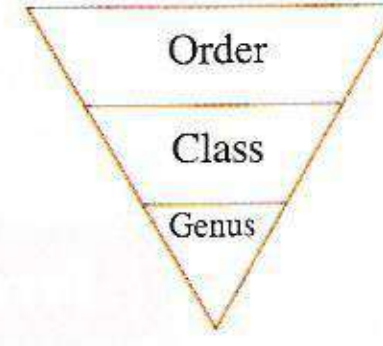
(a)



(b)



(c)



(d)

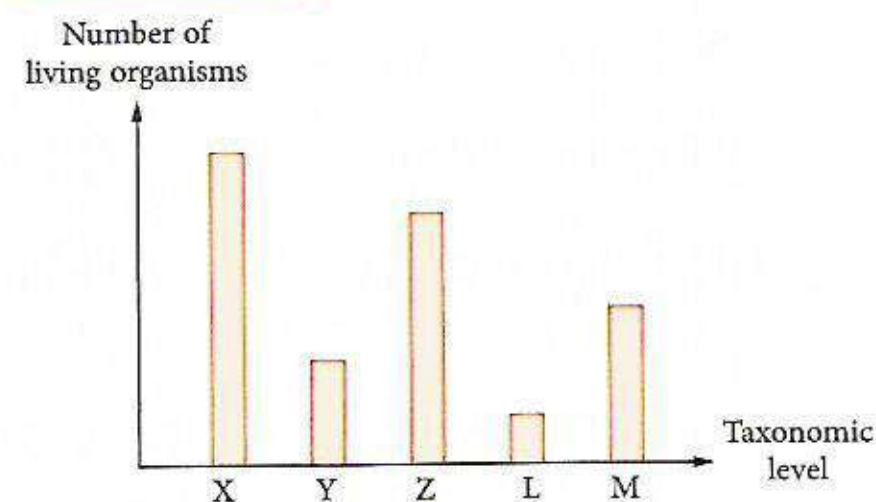
- 7 The opposite graph illustrates different taxonomic levels, if (X) represents the kingdom, which of the following represents the order ?

(a) Y

(b) Z

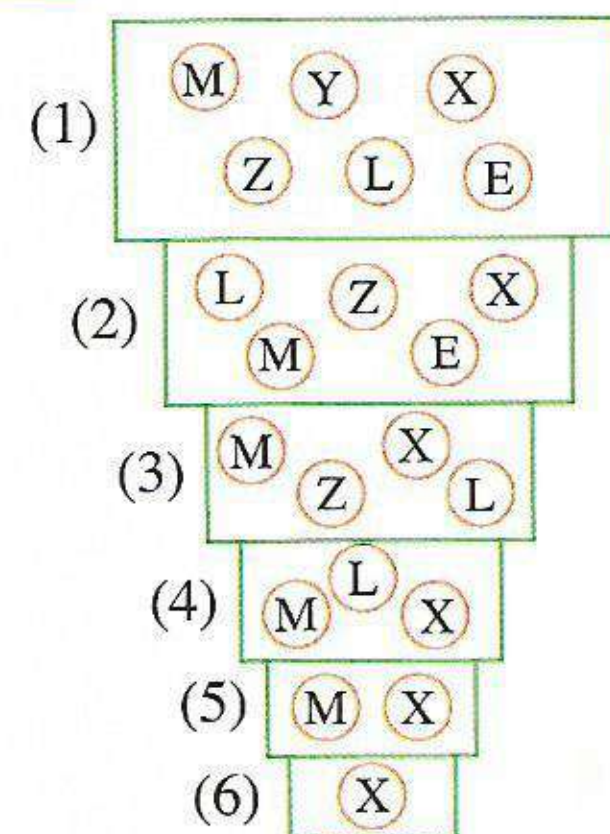
(c) L

(d) M



- 8 If we refer to the phylum with symbol (A) and the class with symbol (B). So, the relationship between (A) and (B) is that
- (a) the number of individuals in (A) is greater than the number of individuals in (B).
 (b) the number of individuals in (A) is less than the number of individuals in (B).
 (c) the number of individuals in (A) is equal to the number of individuals in (B).
 (d) the number of individuals in (A) is equal to half the number of individuals in (B).

- 9 If the number (1) represents a level in the taxonomic hierarchy of kingdom Animalia and the letters found in it represent some of the living organisms that belong to it :



- (1) The highest taxonomic level that includes organisms (X) and (Z) is the
- (a) phylum. (b) class.
 (c) family. (d) order.
- (2) Which of the following represents the least taxonomic level that organisms (L) and (Z) belong to ?
- (a) Class. (b) Order. (c) Family. (d) Genus.
- (3) "Organism (M) shares more traits with organism (L)". "Organism (M) shares less traits with organism (E)".
- (a) The first statement is correct and the second statement is wrong.
 (b) The first statement is wrong and the second statement is correct.
 (c) The two statements are correct.
 (d) The two statements are wrong.

(4) "Organism (X) shares more traits with organism (Y)". "Organism (X) shares less traits with organism (M)".

- (a) The first statement is correct and the second statement is wrong.
- (b) The first statement is wrong and the second statement is correct.
- (c) The two statements are correct.
- (d) The two statements are wrong.

10 The opposite table represents a group of numbers of the taxonomic levels of class Mammalia (knowing that symbol (X) represents the order), study it, then answer :

X	Y	Z	L
29	1230	5700	153

(1) Which of the following represents the number of Mammalia genera ?

- (a) X
- (b) Y
- (c) Z
- (d) L

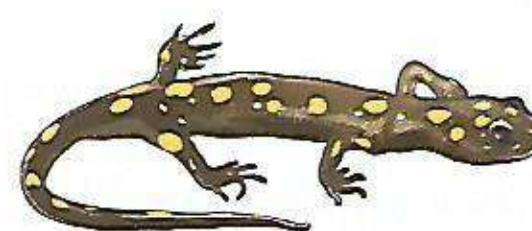
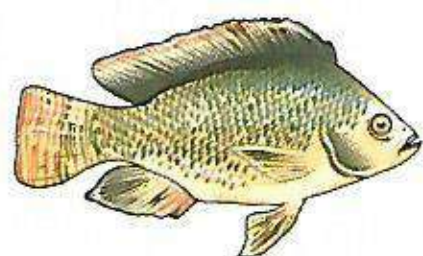
(2) Which of the following statements is correct ?

- (a) The taxonomic level (Y) represents a part of the taxonomic level (Z).
- (b) The taxonomic level (L) represents a part of the taxonomic level (X).
- (c) The taxonomic level (X) represents a part of the taxonomic level (Z).
- (d) The taxonomic levels (X) and (Y) represent a part of the taxonomic level (L).

(3) Which of the following contains individuals that can mate with each other to produce fertile offsprings ?

- (a) X
- (b) Y
- (c) Z
- (d) L

11 What is the taxonomic group which gathers the following organisms ?



- (a) Order.
- (b) Class.
- (c) Genus.
- (d) Kingdom.

12 The following figures represent three bears belong to the same

[Choose two answers]



Ursus arctos



Ursus americanus

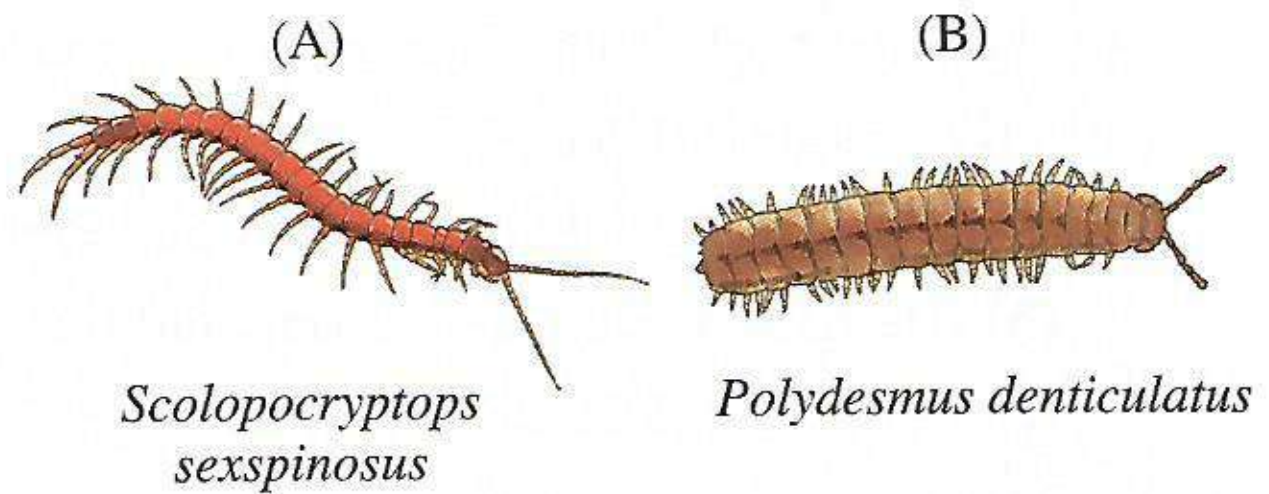


Ailuropoda melanoleuca

- (a) subphylum.
- (b) family.
- (c) genus.
- (d) species.
- (e) kingdom.

- 13 In the two opposite figures, organism (A) shares organism (B) in that they belong to the same

(a) species. (b) genus.
(c) subgenus. (d) class.



- 14 The scientific name of rat is *Rattus rattus*, these two syllables indicate the

(a) kingdom and genus. (b) kingdom and species.
(c) genus and species. (d) phylum and genus.

- 15 Bean plant is from the dicotyledonous plants, which of the following expresses its binomial nomenclature ? [Choose two answers]

(a) vicia faba. (b) Vicia Faba. (c) Vicia faba.
(d) VICIA FABa. (e) Vicia faba.

- 16 If the scientific name of onion is *Allium cepa* and the scientific name of garlic is *Allium sativum*. So, both of them differ in

(a) kingdom. (b) phylum. (c) genus. (d) species.

- 17 If the number of individuals in one of the Animalia phyla is about 3 millions. So, the number of individuals in a class in this phylum may be million(s).

(a) 9 (b) 6 (c) 3 (d) 1

- 18 If the scientific name of potato is *Solanum tuberosum* and the scientific name of sweet potato is *Ipomoea batatas*, in which taxonomic level are they similar ?

(a) Phylum. (b) Subgenus. (c) Genus. (d) Species.

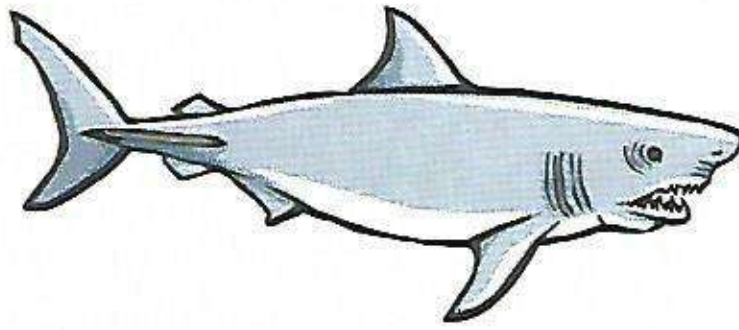
- 19 If we symbolize Carnivora by a circle and Felidae by a square, which of the following figures represents the taxonomic relationship between them ?



- 20 The wheat plant is from the monocotyledonous plants, which of the following expresses the scientific name of wheat ?

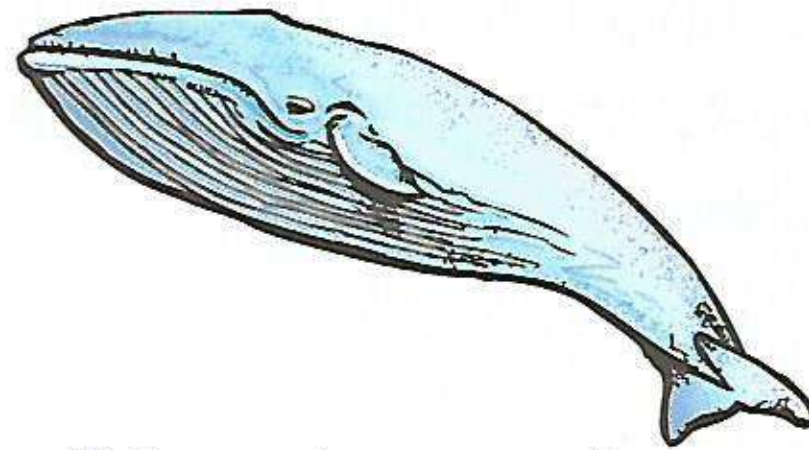
(a) *Triticum Aestivum*. (b) *triticum Aestivum*.
(c) *triticum aestivum*. (d) *Triticum aestivum*.

21 Which of the following figures represents the scientific name of the animal ?



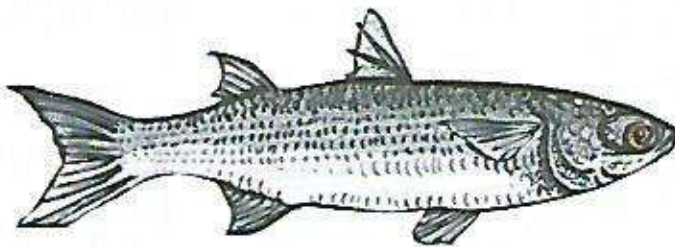
Carcharodon carcharias

(a)



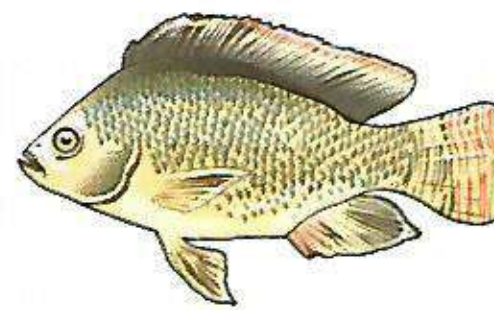
Balaenoptera musculus

(b)



Mugil cephalus

(c)

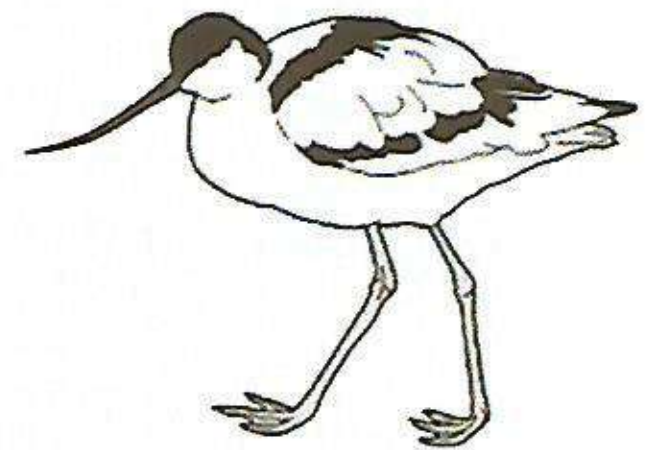


Tilapia Nilotica

(d)

22 All the following can be used to make a dichotomous key to recognize the animal shown in the opposite figure, except

- (a) the beak (longer or shorter) than the head.
- (b) the head vertex (white or black).
- (c) the reproduction (sexual or asexual).
- (d) the skin membrane between toes (present or absent).



Second




Miscellaneous Questions

- 1 **What happens in case of :** the absence of classification system in living organisms ?
- 2 "In some cases, new individuals are produced from the mating of two different species of living organisms". **How far this statement is correct ? With explanation.**
- 3 **The following living organisms represent a group of vertebrates :**

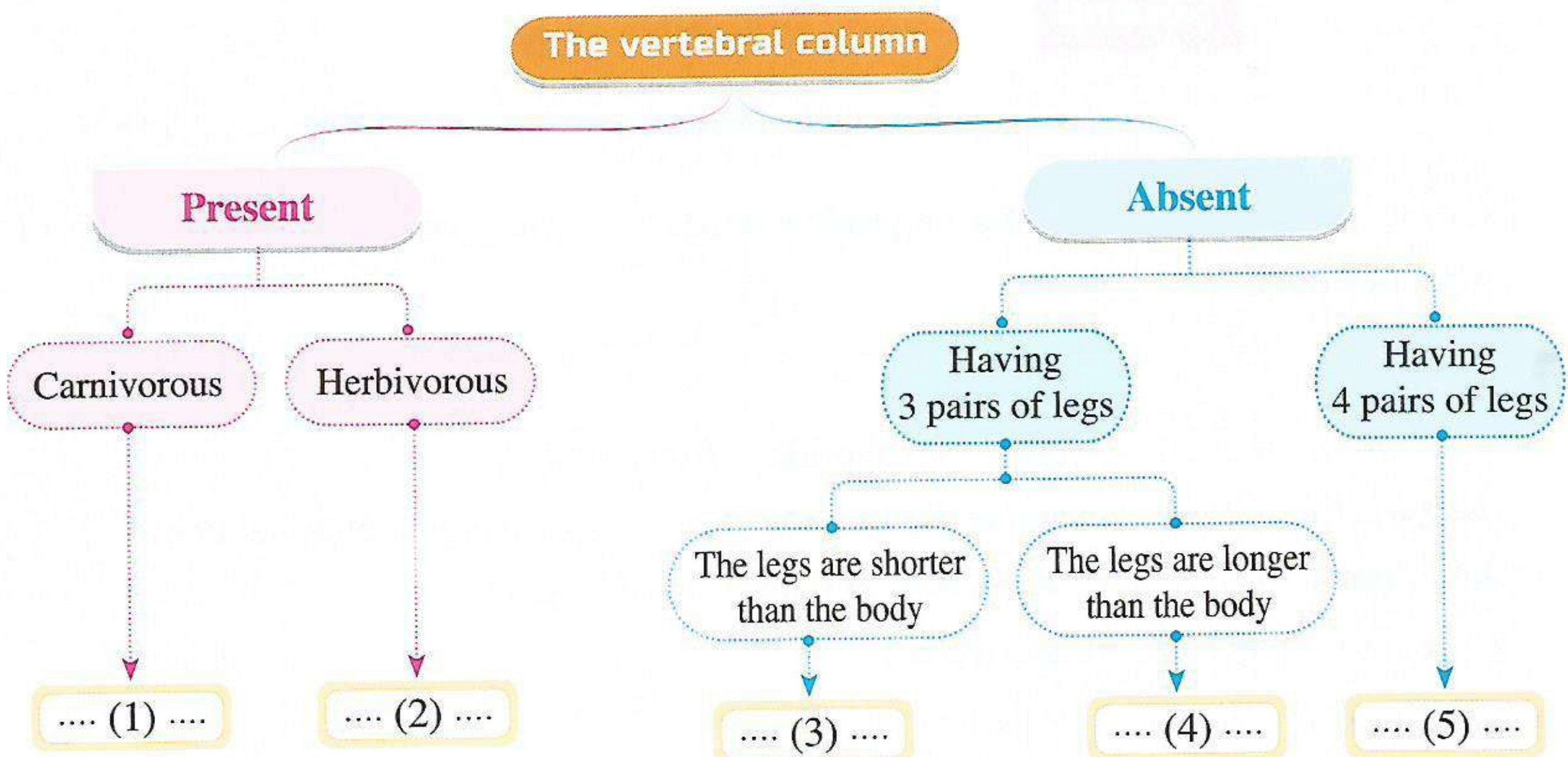
(Frog – Crocodile – Hawk – Cat)

Design a bilateral dichotomous key to classify these organisms, depending on the following characters according to their arrangement :

- The type of skin (naked or covered).
- The type of the skin cover (hairs or scales).
- The scales (scales along the body or scales on the legs).

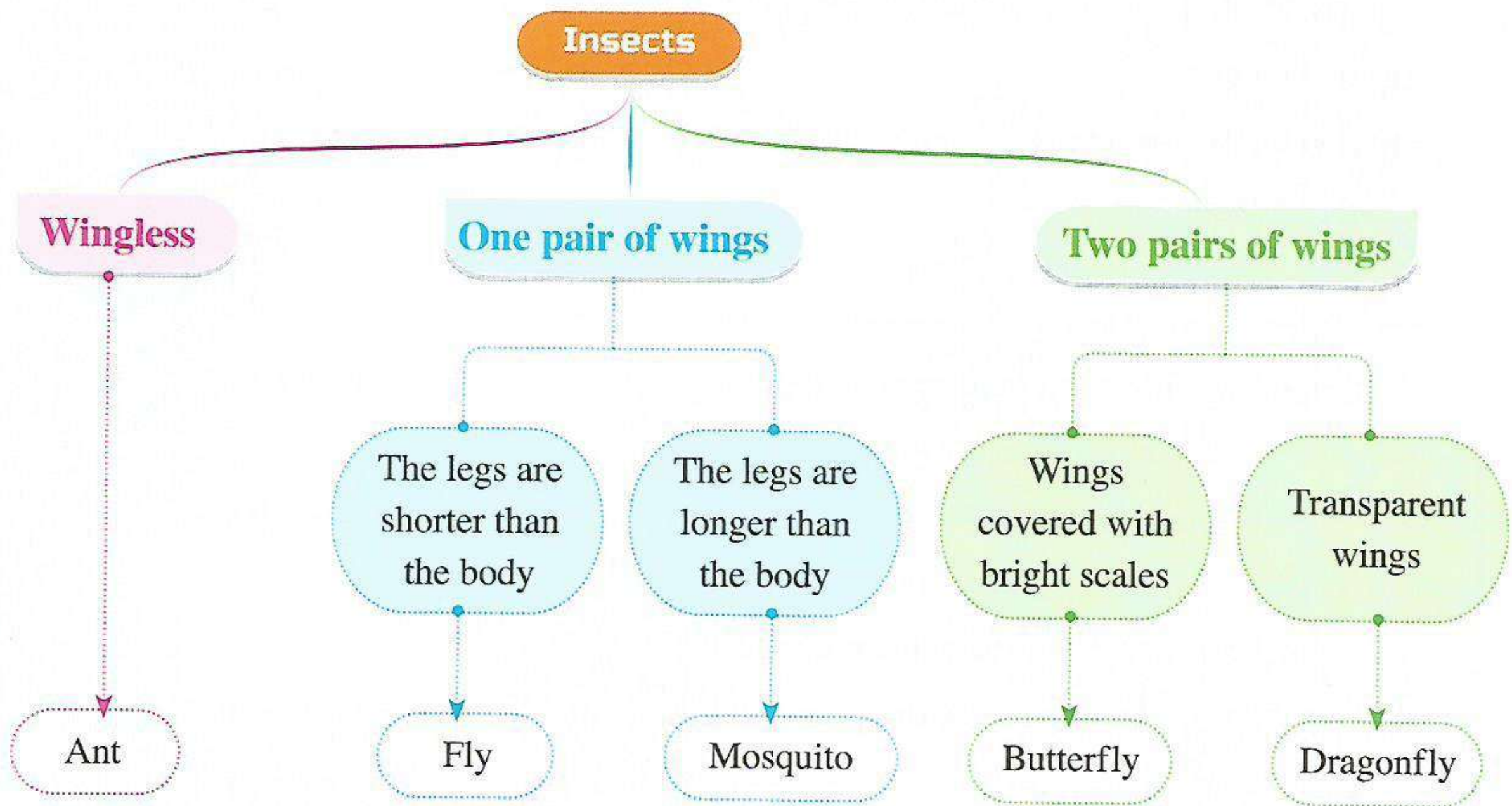
- 4  A mating occurred between organisms (A) and (B), the resulted generation has the characters of the parents and this generation inherits the new characters to its offsprings. In the light of your study to the base that the scientists depend on to put the system of modern classification, deduce the taxonomic relationship between organisms (A) and (B).
- 5 Write the similarities and differences between :
 (a) Mule and tigon. (b) Mule and donkey.
- 6 "There are seven levels only to classify the living organisms". How far this statement is correct ? With explanation.
- 7  A mating occurred between organisms (A) and (B), the resulted generation has the characters of the parents, but this generation is sterile. In the light of your study to the base that the scientists depend on to put the system of modern classification :
 (a) Deduce the taxonomic relationship between organisms (A) and (B). And explain your answer.
 (b) Determine the least taxonomic level to which organisms (A) and (B) belong.
- 8  Put the following living organisms in their suitable places using the bilateral dichotomous key :

(Cat – Fly – Rabbit – Mosquito – Spider)



- 9 "The scientists of taxonomy need to name the living organisms with a standard common names". **How far this statement is correct ? With explanation.**



- 10 The following diagram illustrates a dichotomous key, study it, then mention its mistakes, then correct it with explanation, and write the correct dichotomous key :



Principles of Living Organisms Classification



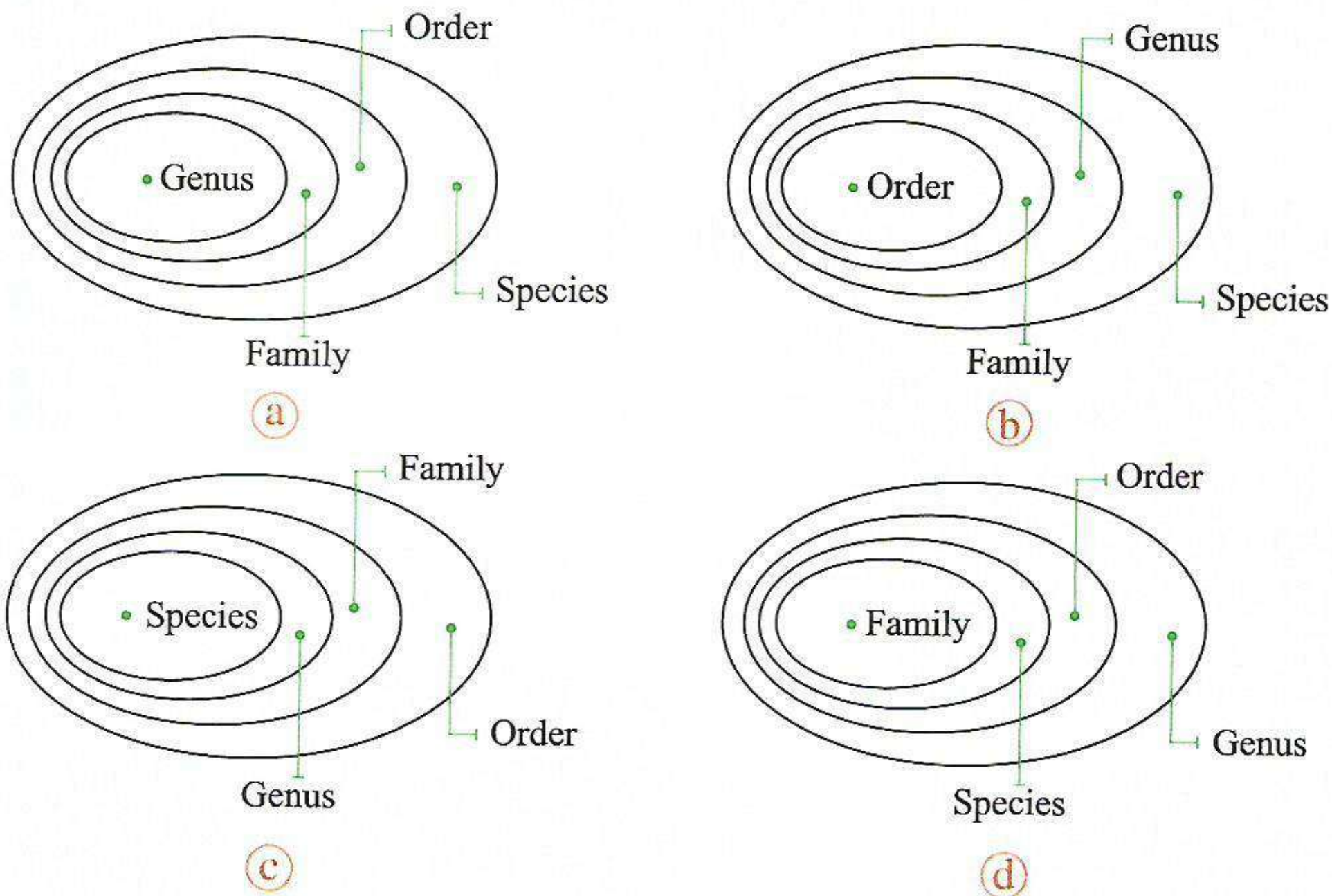
Choose the correct answer (1 : 10) :

- 1  The mule is not given the term "species", because
 - (a) it is sterile.
 - (b) it is unable to mate and can't produce new individuals.
 - (c) it is hermaphrodite.
 - (d) it is dissimilar to its parents.
- 2 Which of the following statements is not applied to Carlous Linnaeus system for the nomenclature of living organisms ?
 - (a) The scientific name of the living organism is written in Latin language.
 - (b) The first letters of genus and species are capital.
 - (c) "Binomial name" is enough for each living organism.
 - (d) The first name represents the genus, while the second name represents the species.
- 3  The correct ascending order to classify living organisms is
 - (a) family / order / subclass / class / subphylum / phylum.
 - (b) family / order / class / subclass / phylum / subphylum.
 - (c) phylum / subphylum / class / subclass / order / family.
 - (d) subphylum / phylum / subclass / class / family / order.
- 4 The family in the taxonomic hierarchy is placed in the taxonomic level
 - (a) preceding the order and following the phylum.
 - (b) preceding the genus and following the order.
 - (c) preceding the phylum and following the species.
 - (d) preceding the kingdom and following the order.
- 5 If the number of organisms in one of the orders is 30231, so, the lower number than that will be in the
 - (a) kingdom.
 - (b) phylum.
 - (c) class.
 - (d) family.

6 In a forest, the scientists discovered two new organisms and classified them in the same phylum, but they were different in the order. So, it is expected that they will be in the same

- (a) class. (b) family. (c) species. (d) genus.

7 Which design represents the classification of living organisms ?



8 Each group in the levels of the taxonomic hierarchy includes organisms with

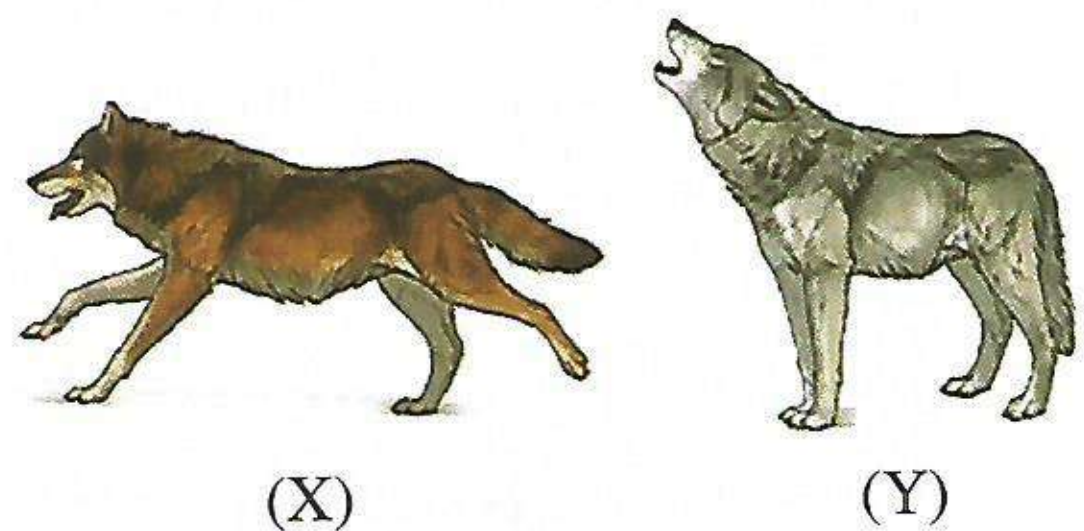
- (a) smaller numbers and share more similar characters than the following group.
 (b) smaller numbers and share less similar characters than the preceding group.
 (c) greater numbers and share more similar characters than the preceding group.
 (d) greater numbers and share less similar characters than the following group.

9 Which of the following taxonomic levels is characterized by a high diversity in living organisms ?

- (a) Class. (b) Phylum. (c) Family. (d) Species.

- 10 From the two opposite figures :
The morphological difference between (X) and (Y) is due to being different in their

- (a) family. (b) class.
(c) genus. (d) species

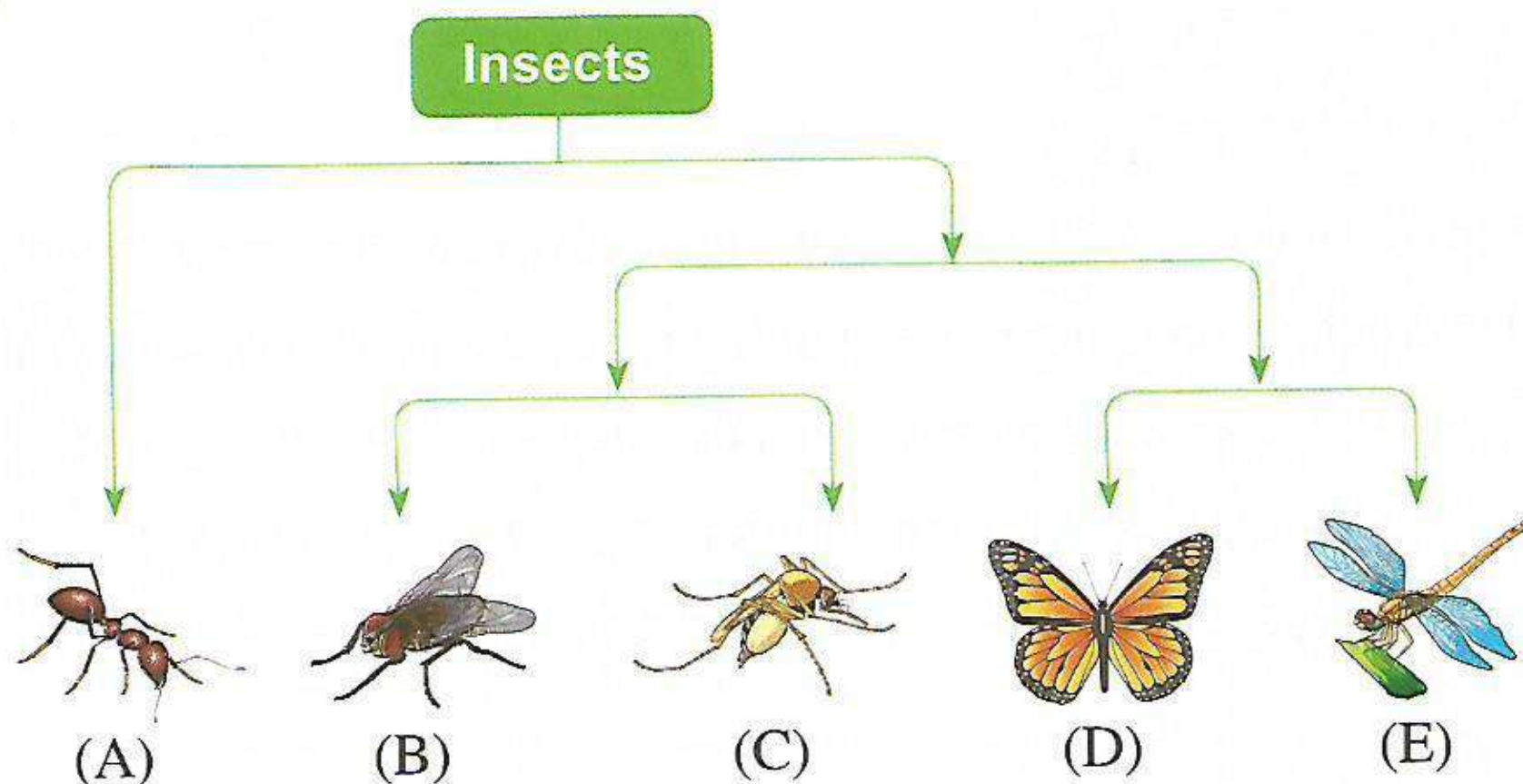


Answer the following questions (11 : 17) :

- 11 Write the similarities and differences between :

	Tigon	Tiger
Similarities :		
Differences :		

The following diagram illustrates the dichotomous key of some insects (A), (B), (C), (D) and (E) :



- 12 Which character is common between insect (B) and insect (C) ?

- 13 Which character is different between insect (B) and insect (D) ?

- 14 Which character is different between insect (A) and insect (E) ?

15 What happens in case of : discovering a new living organism "according to taxonomy" ?

16 Determine the relationship between phylum Chordata and class Mammalia.

17 "The individuals of the same genus can mate with each other to produce fertile offsprings". How far this statement is correct. With explanation ?

CHAPTER 2

LESSON ONE

- Kingdom Monera.
- Kingdom Protista.

★ Attempts of classifying the living organisms :

The Latin philosopher Aristotle (more than 2300 years ago)

- He was the first who classified :
 - The animals into red-blooded animals and bloodless animals.
 - The plants into trees, shrubs and weeds.



The scientist Carolus Linnaeus (1700)

- He established the traditional classification system, where he classified the living organisms into two kingdoms only, which are :
 - Animal kingdom.
 - Plant kingdom.



The scientist Robert H. Whittaker (1969)

- He established the modern system of classification, where he classified the living organisms into five kingdoms, which are :
 - Monera. - Protista. - Fungi.
 - Plantae. - Animalia.
- The development of the scientific techniques used in the biological field and increasing the knowledge had helped Whittaker in establishing his modern classification system.

This modern system is considered the conventional system in the scientific communities till now.



Note

There are some organisms that were not subjected to Whittaker classification, because they gather between the characteristics of living organisms and non-living things, and from the examples of these organisms are :

- (1) Viruses, like : • Poliomyelitis. • HIV
• Measles. • Influenza.
(2) Viroids. (3) Prions.

1 Test yourself

Answered

Choose the correct answer :

The two following diagrams illustrate one type of classification of living organisms :



Who is the scientist that established this classification ?

- (a) Whittaker. (b) Aristotle. (c) Carolus Linnaeus. (d) Sutton.

• Ask for



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Mathematics Applications

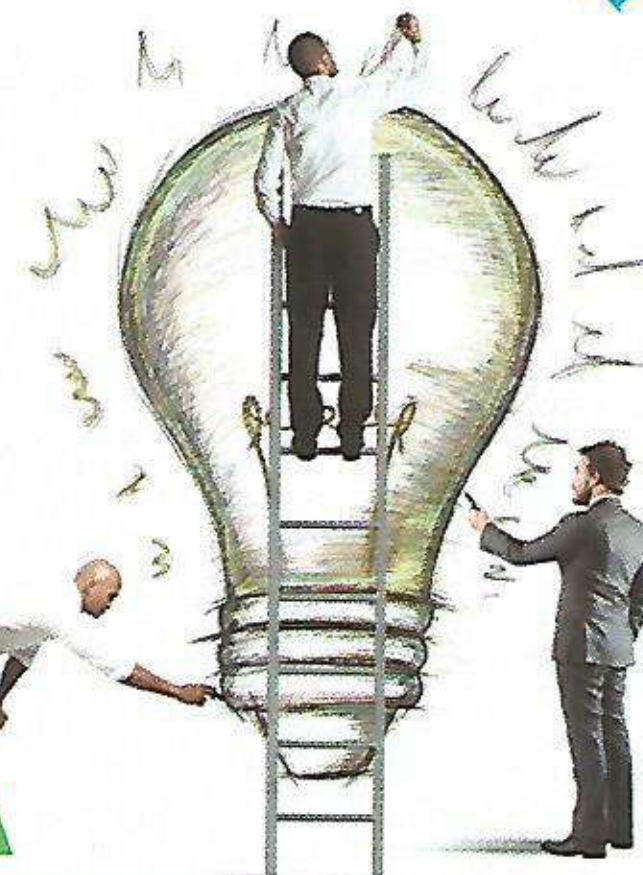
New Hello English

Chemistry

Physics

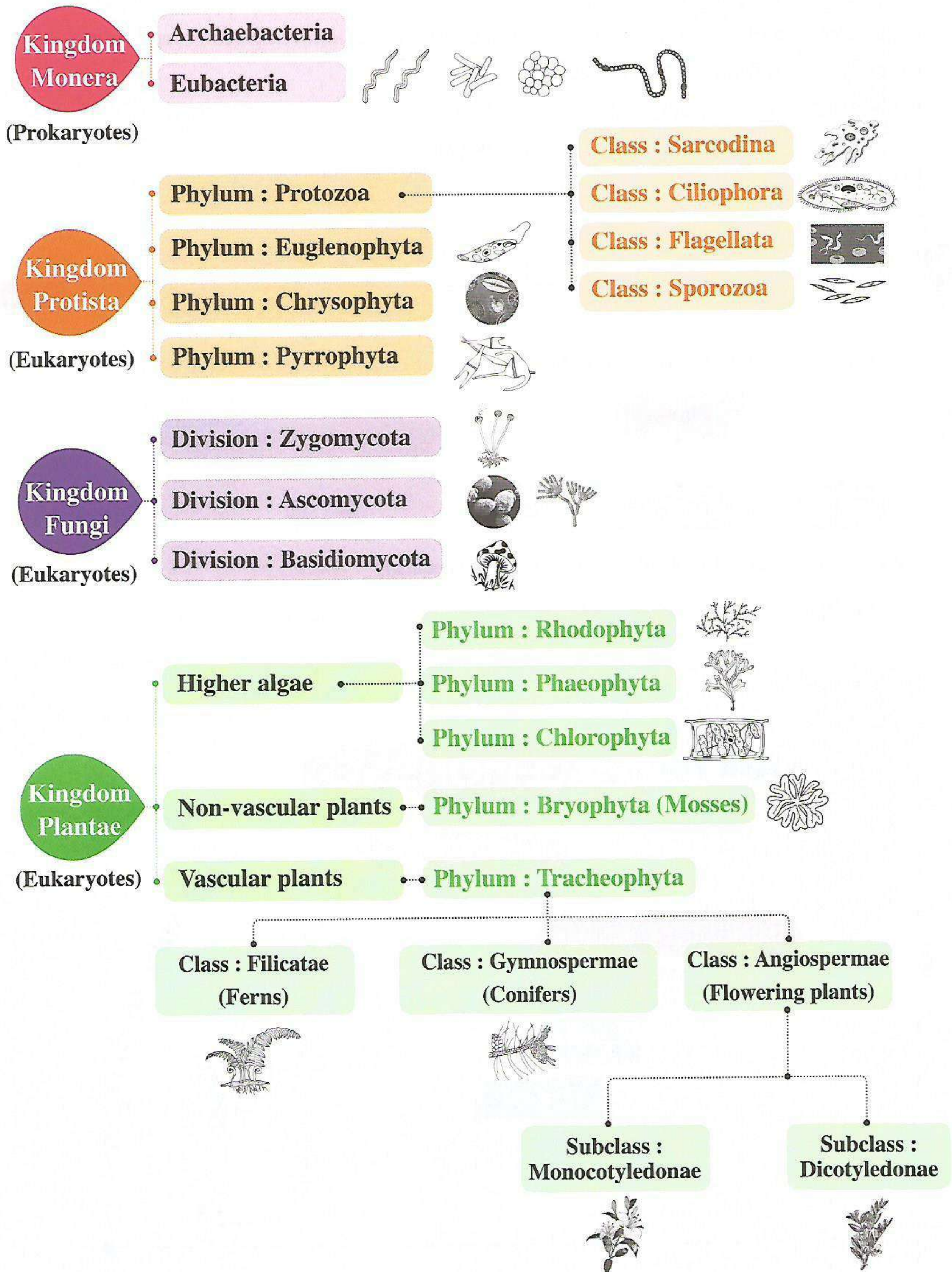
Biology

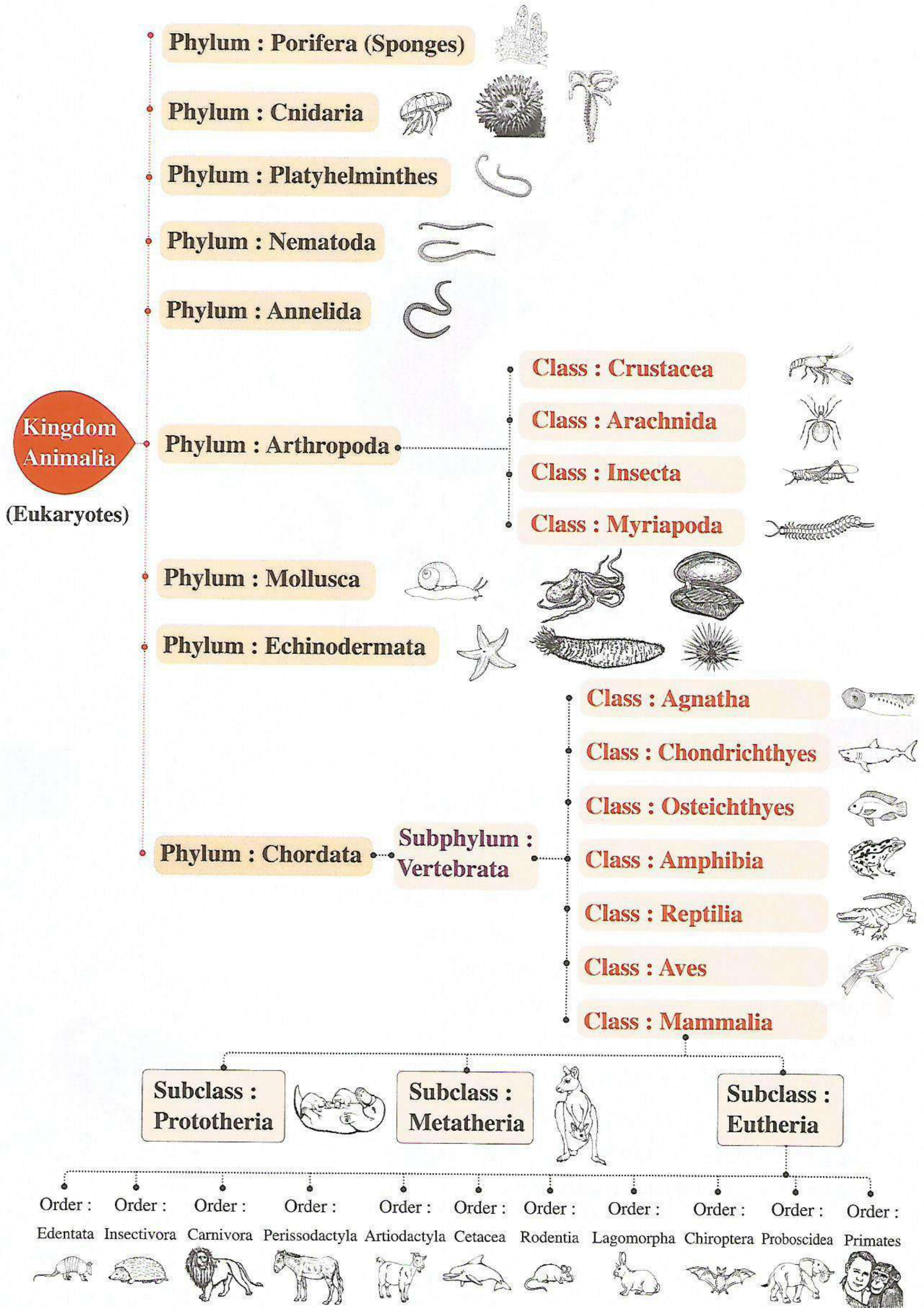
En Français



Your way to Success

Modern classification of living organisms





★ Figure illustrates the modern classification of living organisms :



First

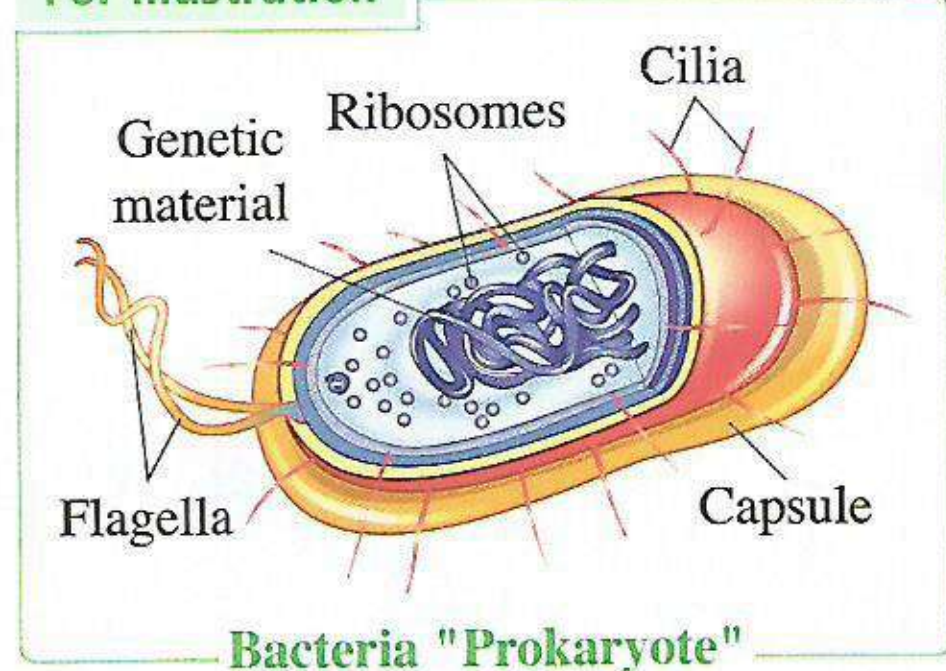
Kingdom Monera



General characteristics of kingdom Monera

- **Mode of living** : it may live individually or in colonies.
- **Structure** : its body consists of one cell (unicellular organisms).
- **Nucleus** : it is **prokaryotic**, i.e. it doesn't have a definite shape, where the genetic material found in the cytoplasm is not surrounded by a nuclear membrane from outside.
- **Cell wall** : it is devoid of cellulose or pectin.
- **Cytoplasm** : it is lack of many membranous organelles, such as mitochondria, plastids, Golgi apparatus and endoplasmic reticulum.
- **Kingdom Monera is classified into two different divisions which are :**
 - 1 Archaeobacteria.
 - 2 Eubacteria.

For illustration

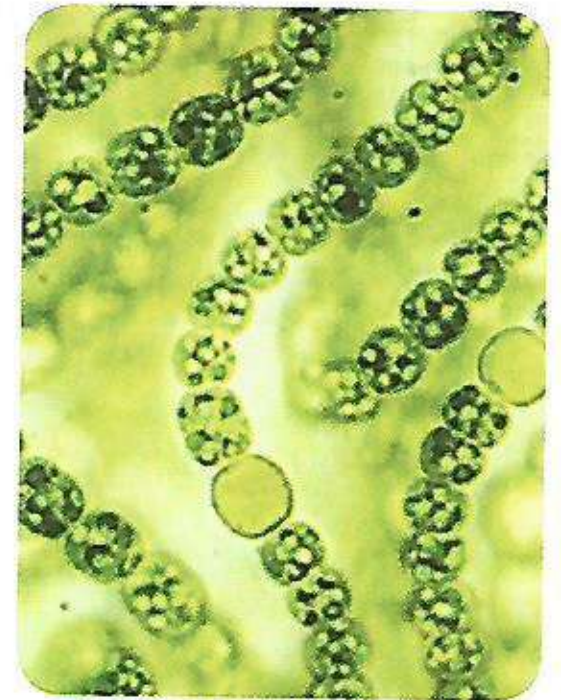


1 Archaeobacteria

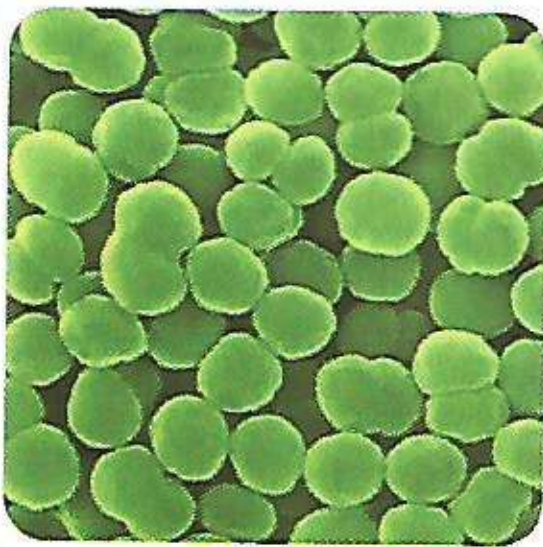
- **Mode of living** : most of them survive in harsh environmental conditions, such as :
 - Hot springs.
 - Environments devoid of oxygen.
 - High salty water.
- They differ from the Eubacteria in the structure of both **cell membrane** and **cell wall**.

2 Eubacteria

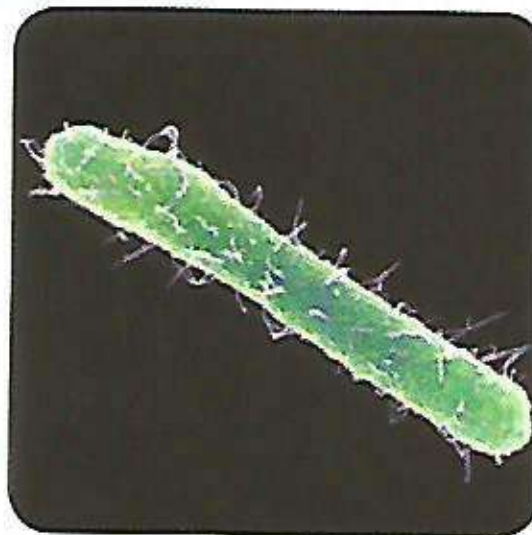
- **Mode of living** : they live everywhere in all Earth's environments, such as :
 - Air.
 - Land.
 - Water.
- **Nutrition** : some of them are **autotrophic**, such as *Cyanobacteria*, e.g. *Nostoc*, while others are **heterotrophic**.
- **Reproduction** : they reproduce asexually by **binary fission**.
- **Shapes** : they have several shapes (forms), such as :



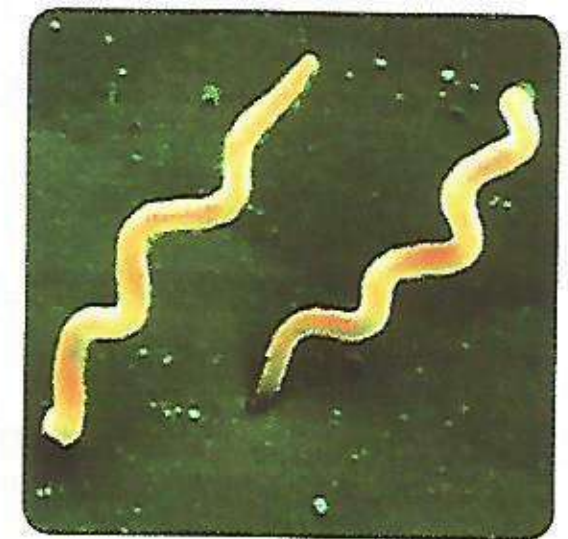
Nostoc



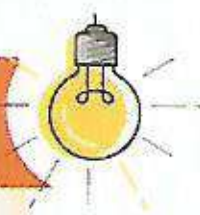
Spherical-shaped bacteria (Cocci)



Rod-shaped bacteria (Bacilli)



Spiral-shaped bacteria (Spirilla)



Practical Activity

1 Shapes and characteristics of bacteria :

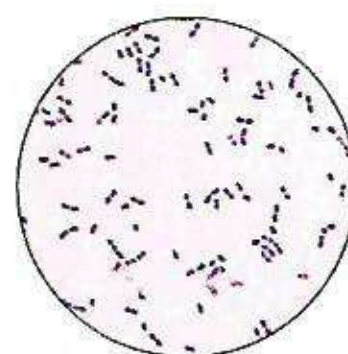


1. Used materials and tools :

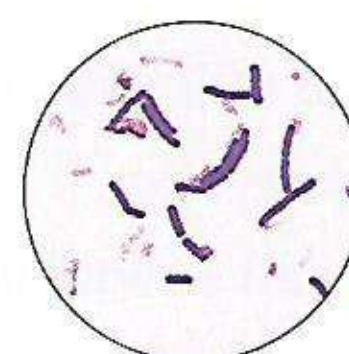
- Slides of the three samples of bacteria : spherical-shaped (**Cocci**), rod-shaped (**Bacilli**) and spiral-shaped (**Spirilla**).
- A compound light microscope with an oil immersion lens.

2. Procedures :

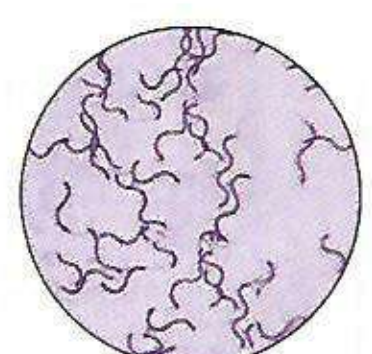
- 1 Examine the numerated slides from (1) : (3) of the three types of bacteria by the oil immersion lens of the light microscope.



Slide (1)



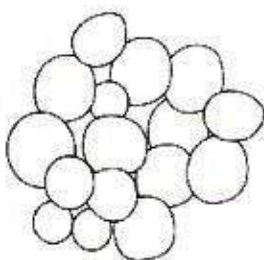
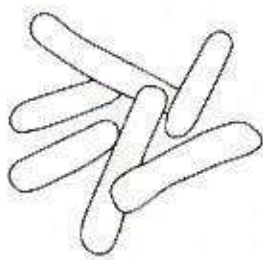
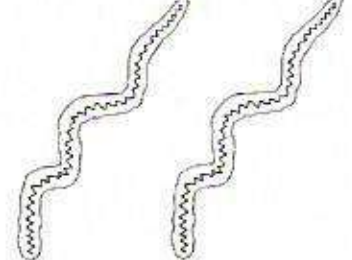
Slide (2)



Slide (3)

- 2 Draw a diagrammatic sketch for each type of bacteria and classify them according to their shapes.

3. The sketch and observations :

	Slide (1)	Slide (2)	Slide (3)
Differences :	 Bacteria type : Spherical-shaped.	 Bacteria type : Rod-shaped.	 Bacteria type : Spiral-shaped.
Similarities :	All of them are unicellular organisms with no definite nucleus.		

- The standard or base used in classifying the three types of bacteria is : the shape of bacteria (spherical, rod and spiral).

4. Conclusion :

Bacteria are classified in a separate kingdom (Monera), because they are characterized by the following characteristics :

- 1 They are unicellular organisms and less developed.
- 2 Their genetic material is not surrounded by a nuclear envelope (nuclear membrane).

Enrichment information

Nanobacteria :

- They are very tiny bacteria, where their size is about 20 : 200 nanometers.
- Scientists disagree to consider them as crystalline structures or a new form of life.
- They grow slowly inside the living cell and their shapes change during their growth stages.
- They are more resistant than the normal bacteria, where they can protect themselves from the defensive systems of the host body by secreting stone shields that surround them as a capsule.
- Researchers reached that this kind of bacteria is a main cause in the formation of kidney stones, atherosclerosis and inflammation of the prostate.

2 Test yourself

Answered

1 Choose the correct answer :

Which of the following indicates that *Nostoc* is different from Archaeobacteria ?

- (a) It is prokaryotic.
- (b) Its cell wall devoid of cellulose.
- (c) It needs sunlight to continue its life.
- (d) Its cytoplasm devoid of some membranous organelles.

② How far the following statements are correct, with explanation :

(1) Archaeobacteria are anaerobic.

.....

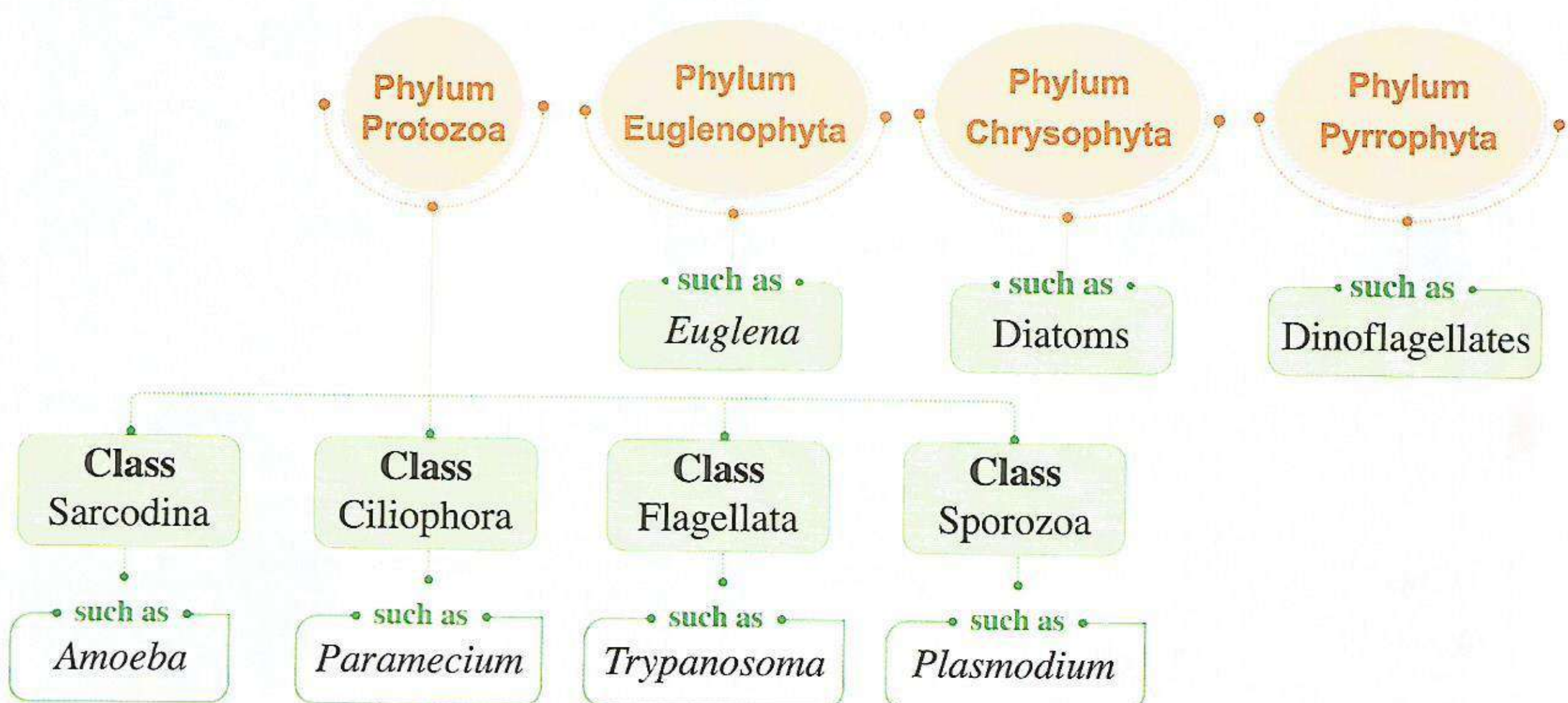
(2) Eubacteria are autotrophic.

.....

Second Kingdom Protista

General characteristics of kingdom Protista

- **Structure** : their structure is not complex, as most of them are unicellular and few of them are multicellular.
- **Nucleus** : it is **eukaryotic**, i.e. the genetic material is surrounded by a nuclear envelope that separates it from the cytoplasm.
- They are different from plants and animals, as they are not complex and some of them have cell wall and plastids.
- **Kingdom Protista is classified into several phyla, the most important ones are :**



1 Phylum Protozoa


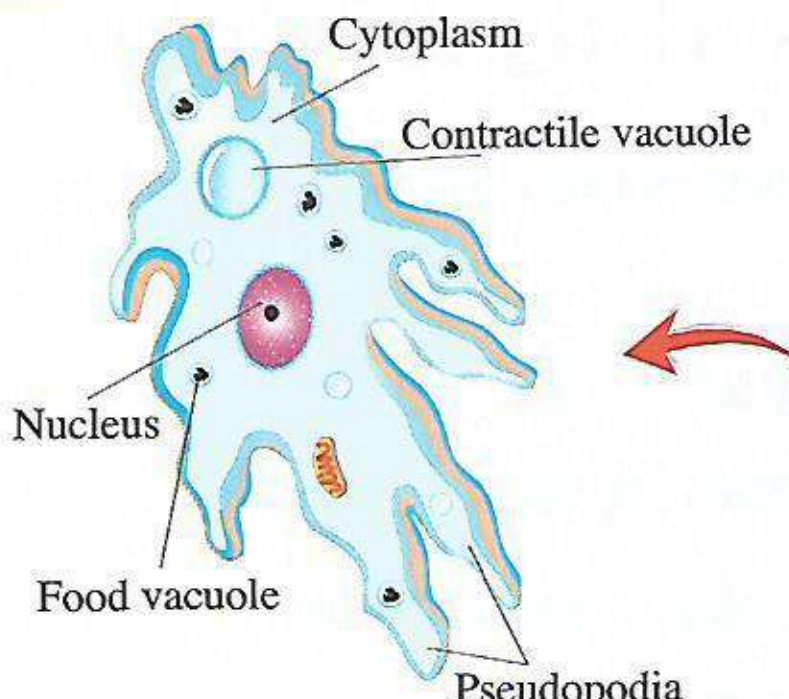

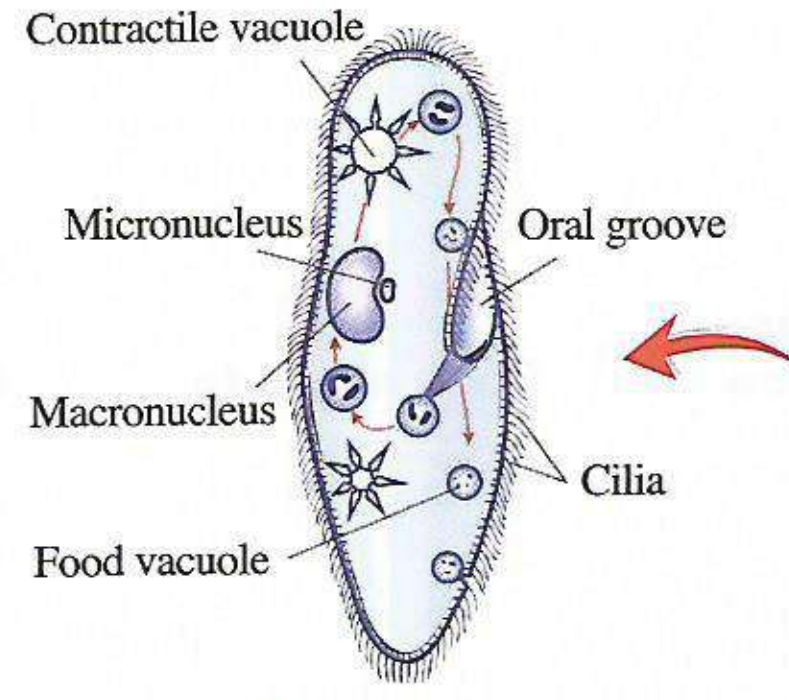

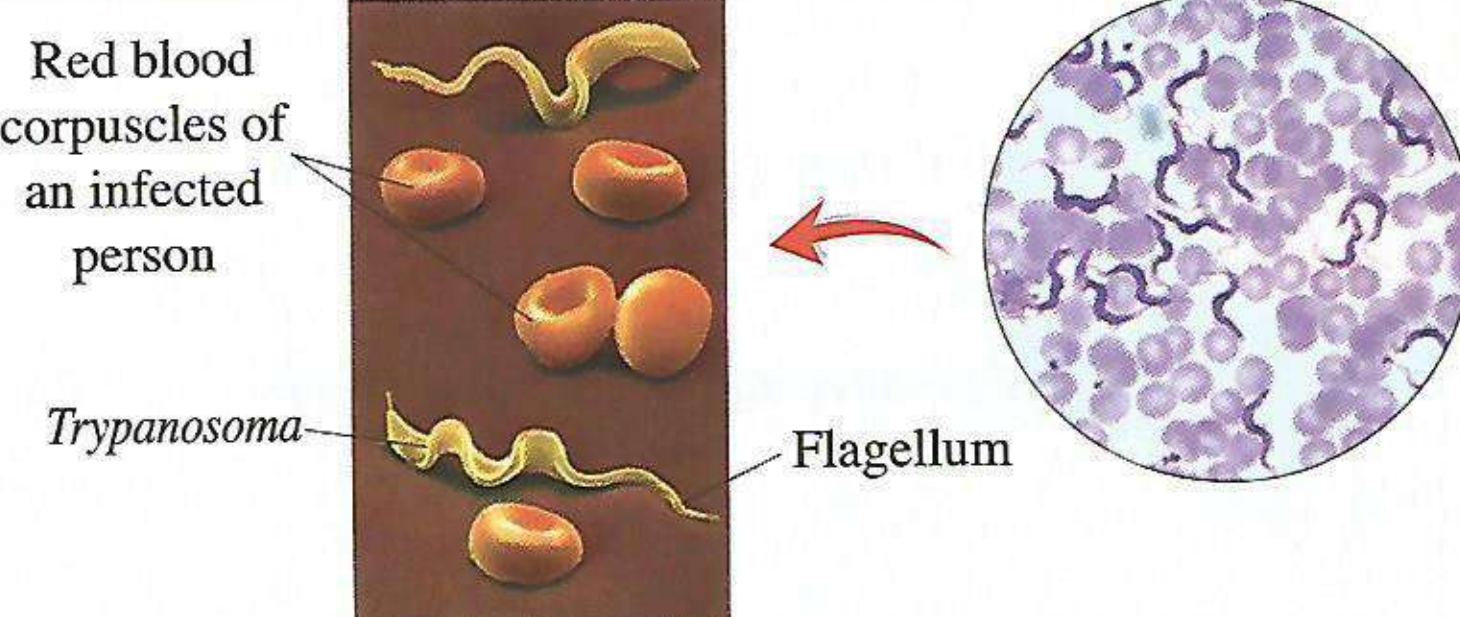
• Mode of living :

- Some of them are free-living, where they may live individually or in colonies in fresh and salt water, as well as in moist soils.
- The others parasitize the plants or animals, causing diseases to them.

• Structure : they are unicellular microscopic animal-like organisms.

• Reproduction : they reproduce sexually and asexually.

• Protozoa is classified into four classes, depending on the mean of locomotion :

Class	Mean of locomotion	Examples
1 Class Sarcodina : 	Pseudopodia (Temporary extensions from the body).	 <i>Amoeba</i>
2 Class Ciliophora : 	Cilia (Surrounding the whole body).	 <i>Paramecium</i>
3 Class Flagellata : 	Flagella	 <i>Trypanosoma</i> (Parasitizes the human and infects him with sleeping sickness).

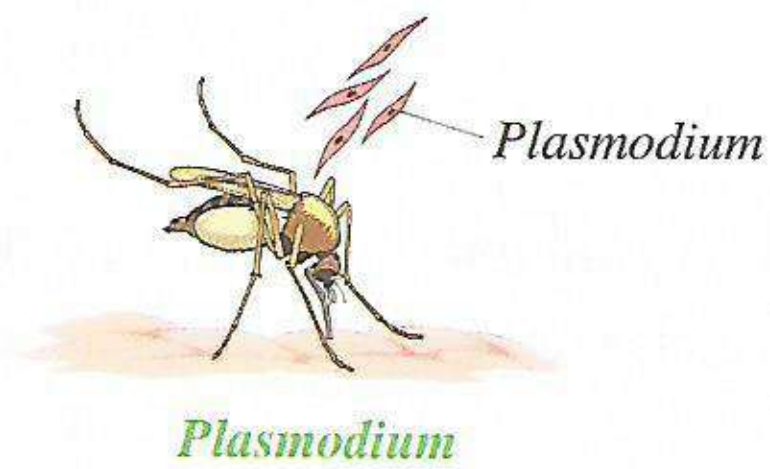
4

Class

Sporozoa :

(They produce phases called spores)

Have no mean of locomotion.



(Parasitizes the human and infects him with malaria disease).

Enrichment information

Sleeping sickness :

- It is one of the widespread diseases in the tropical regions as in Africa.
- It is caused by *Trypanosoma* parasite that is transmitted by tsetse fly, when it bites a human.
- Its symptoms include fever, heavy sweat, headache, hallucination, weakness and tendency to sleep.
- If the patient is not treated in the proper time, he goes into coma which leads to death.

3

Test yourself

Answered

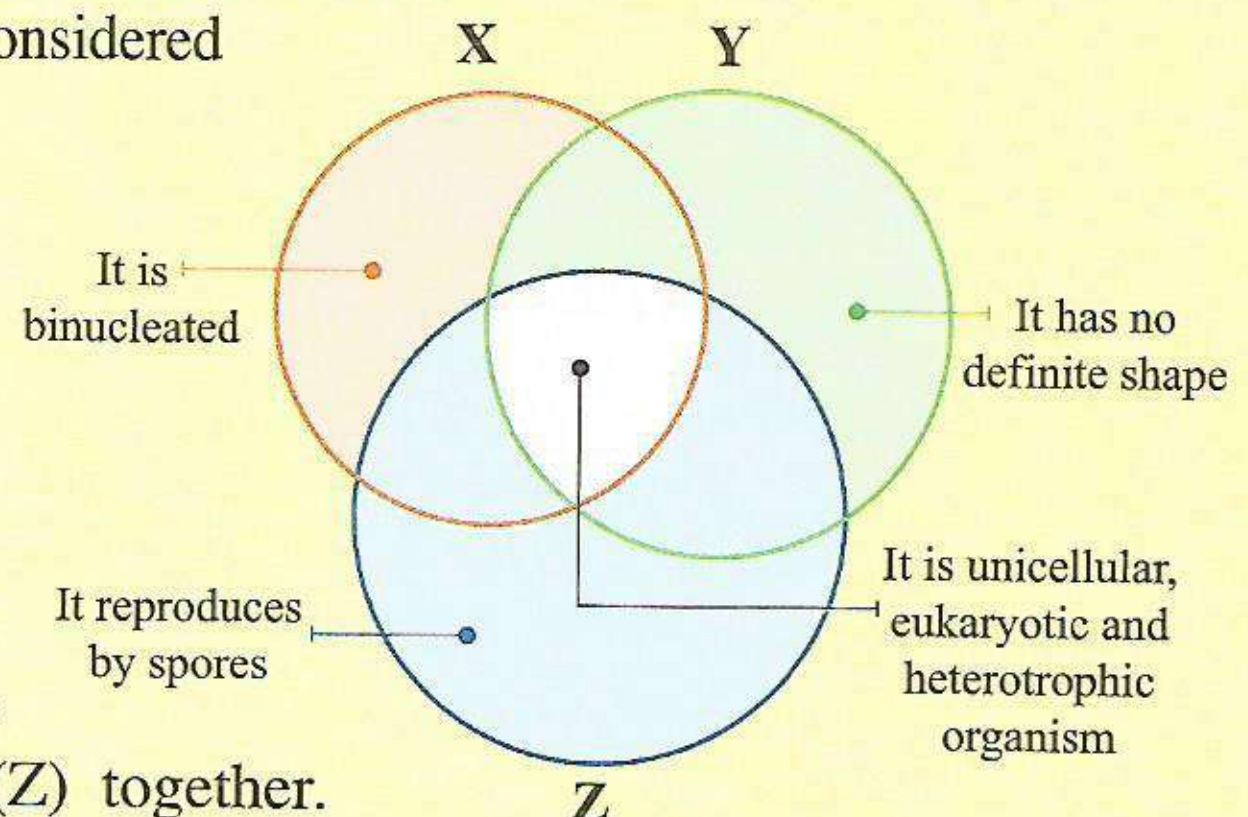
Use the opposite figure, then choose the correct answer :

(1) Which of these living organisms is(are) considered a pathogen ?

- (a) (X). (b) (Z).
(c) (X) and (Y) together.
(d) (X) and (Z) together.

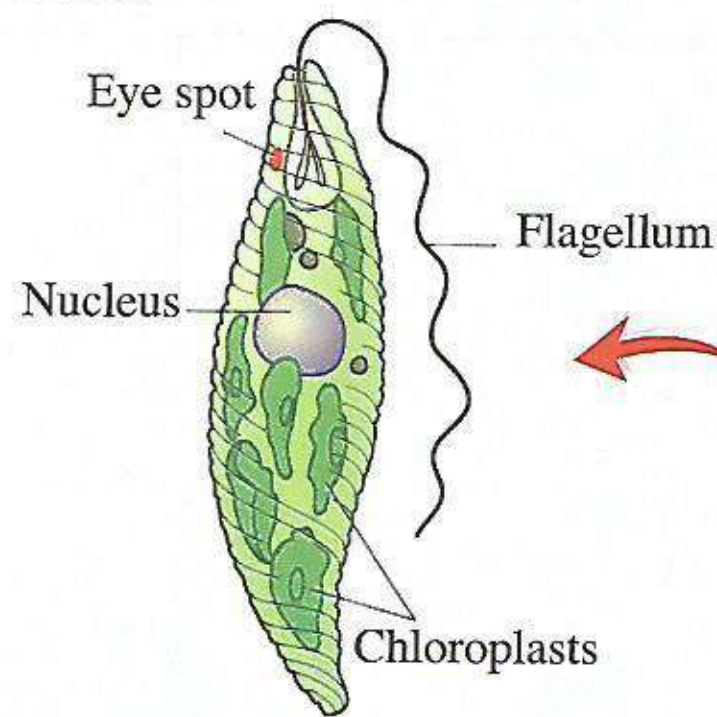
(2) Which of these living organisms is(are) free-living ?

- (a) (X) only. (b) (Z) only.
(c) (X) and (Y) together. (d) (Y) and (Z) together.



2 Phylum Euglenophyta

- **Structure** : unicellular living organisms.
- **Cytoplasm** : it contains green plastids (chloroplasts) which perform photosynthesis.
- **Mean of locomotion** : they move by flagella.
- **Example** : *Euglena*.



Euglena



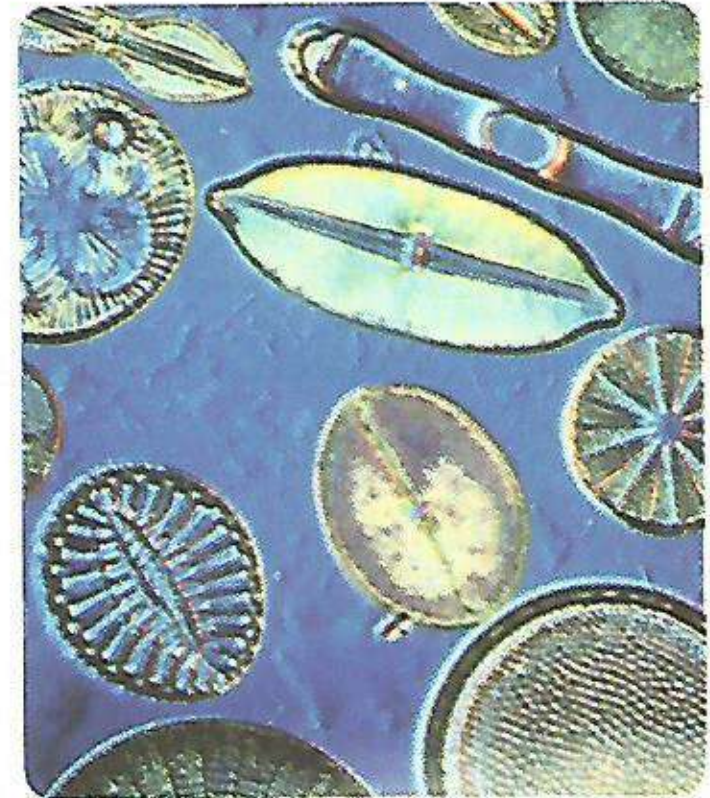
3 Phylum Chrysophyta

- **Structure :**

- Most of them are unicellular and called **Diatoms**.
- They have glass-like cell walls containing **silica**.

- **Economic importance :**

They are considered an important source of food for fish and other marine animals.



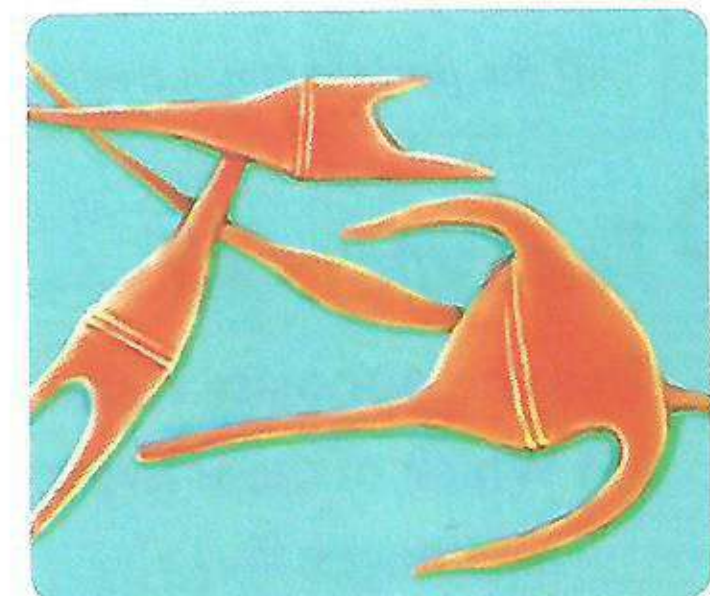
Some forms of diatoms

4 Phylum Pyrrophyta

- **Mode of living :** they live in seas and oceans, where they form a great portion of phytoplanktons.
- They contain a **red pigment** which acquires them the red colour beside the chlorophyll pigment.

- **Example :**

Dinoflagellates represent the largest group of phylum Pyrrophyta and they move by **two flagella**.



Dinoflagellates

Enrichment information

Red tide phenomenon :

- It is a natural phenomenon that occurs in water of seas and oceans, where water is coloured red and this accompanied with the death of thousands of fishes.
- The cause of this phenomenon is attributed to the enormous increase in the numbers of dinoflagellates, when water becomes warm with a plenty of nutrients, these organisms reproduce very rapidly and secrete toxins that kill fishes.



4 Test yourself

Answered

Choose the correct answer :

(1) By using the opposite figure, answer the following questions :

1. Organism (A) may be

- (a) *Amoeba*.
- (b) *Nostoc*.
- (c) *Euglena*.
- (d) *Trypanosoma*.

2. Organism (B) may be

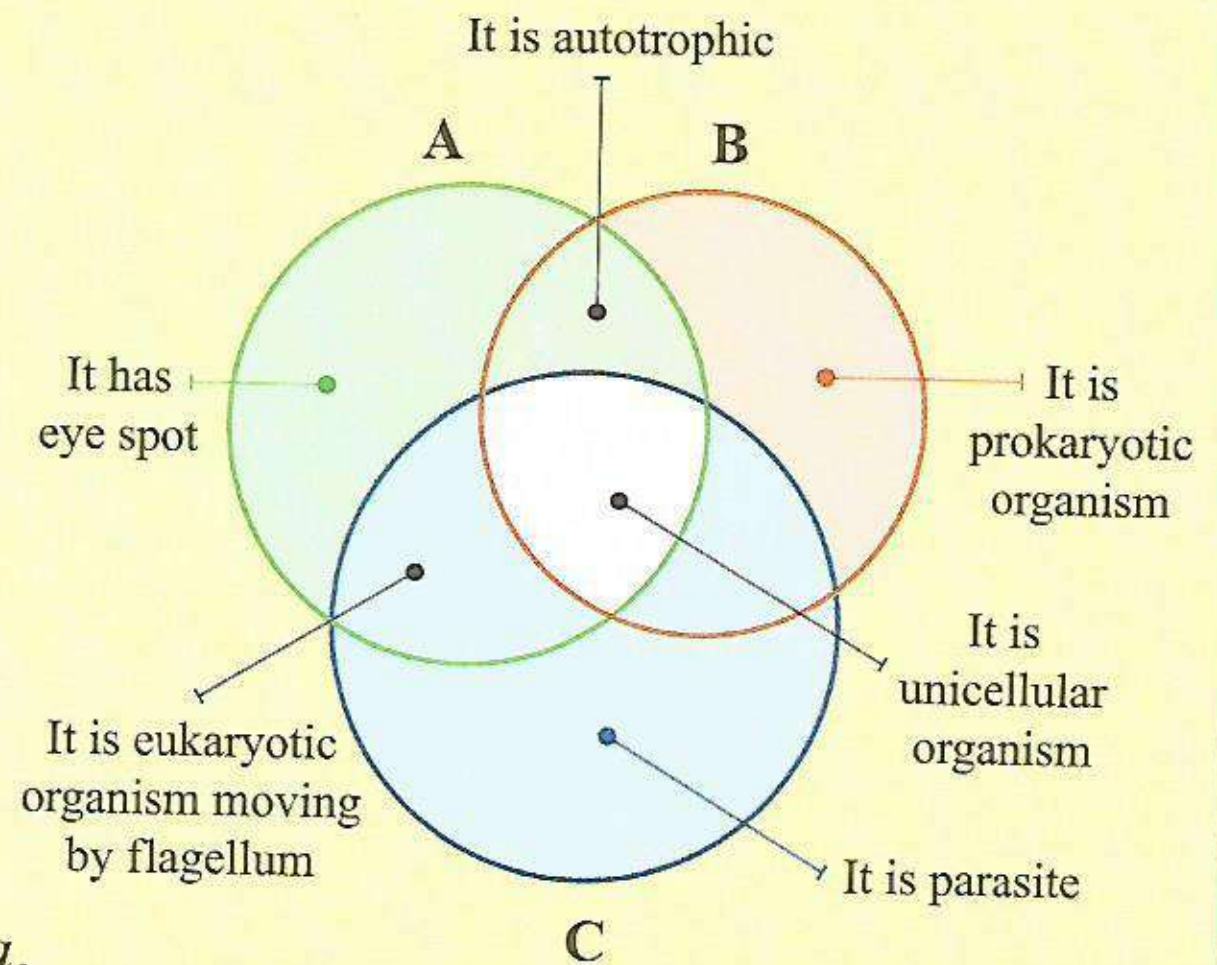
- (a) diatoms.
- (b) *Nostoc*.
- (c) *Paramecium*.
- (d) *Trypanosoma*.

3. Organism (C) may be

- (a) *Plasmodium*.
- (b) *Paramecium*.
- (c) *Euglena*.
- (d) *Trypanosoma*.

(2) Most protists share in being

- (a) prokaryotic and unicellular.
- (b) heterotrophic and eukaryotic.
- (c) autotrophic and prokaryotic.
- (d) unicellular and eukaryotic.



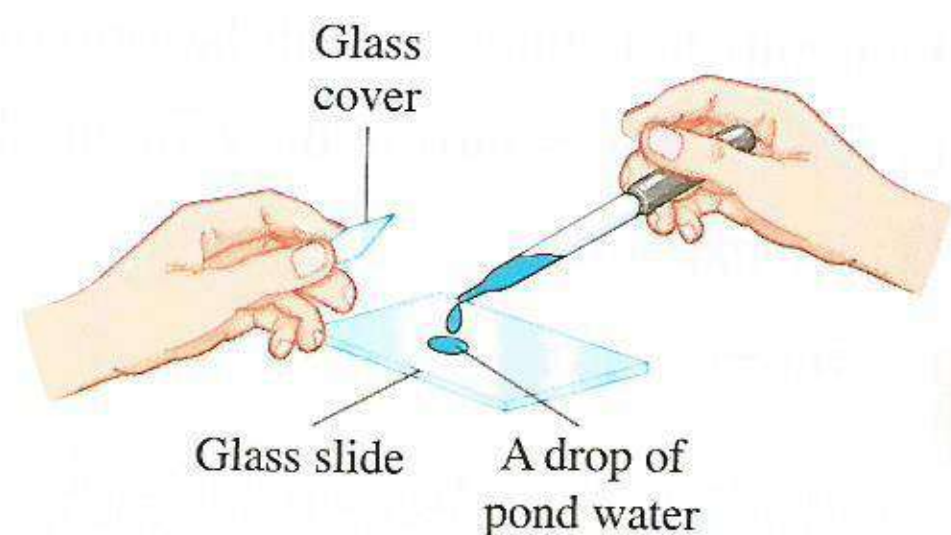
Practical Activity 2

Examining protists in a sample of pond water :



1. Used materials and tools :

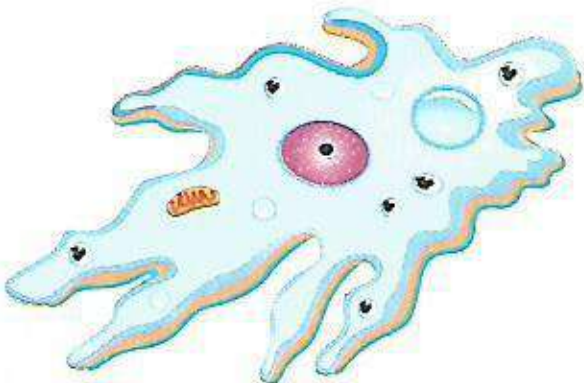
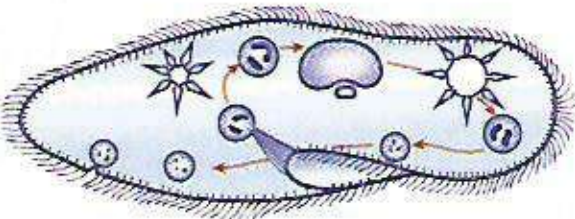
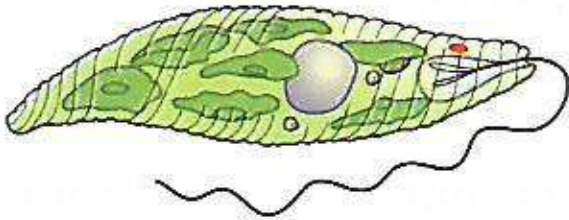
- Pond water.
- Coverslips.
- A compound light microscope.
- Glass slides.
- Glass rod.
- Dropper.



2. Procedures :

- 1 Place a drop of pond water on a glass slide and cover it with a coverslip.
- 2 Examine the slide by using the low power lens of the light microscope.
- 3 Sketch the organisms that you see.
- 4 Describe the different organisms that you observed in the pond water and mention their mean of locomotion.

3. The sketch and observations :

The living organism	Sketch	Observation
<i>Amoeba</i>		It is a unicellular organism, has temporary extensions called pseudopodia extending from its body as it moves by them.
<i>Paramecium</i>		It is a unicellular organism whose body is surrounded by cilia and it moves by them.
<i>Euglena</i>		It is a unicellular organism which contains chloroplasts and moves by flagella.

4. Conclusion :

Pond water contains several protists which differ among each other in the mean and method of locomotion.

5 Test yourself

Answered

Choose the correct answer :

A researcher examined a sample of pond water by using light compound microscope, he identified some unicellular organisms containing extensions from the body that have different shapes during movement, depending on that these organisms may be

- (a) *Paramecium*.
- (b) *Amoeba*.
- (c) *Trypanosoma*.
- (d) *Euglena*.

• Kingdom Monera.
• Kingdom Protista.



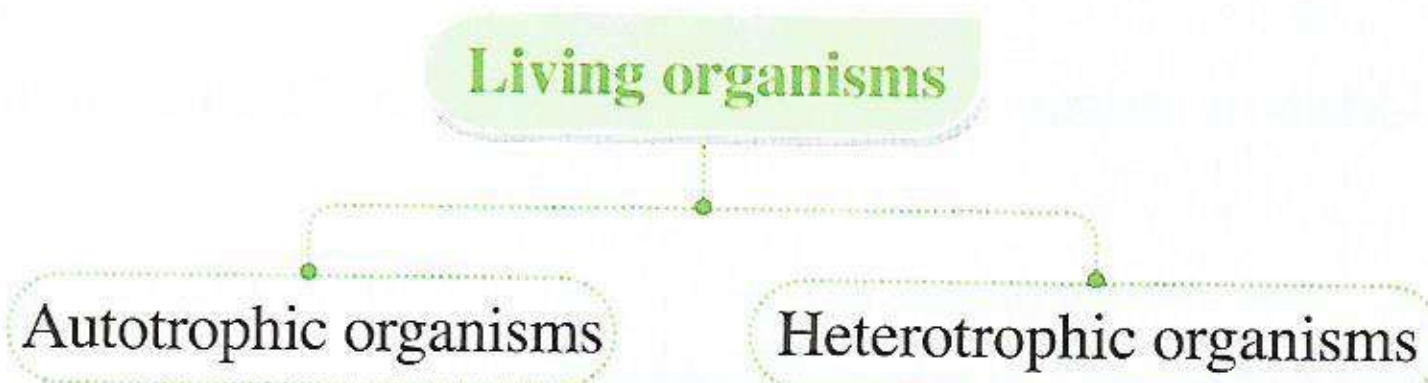
Interactive test

The questions signed by measure the high levels of thinking.

First

Multiple Choice Questions

- 1 Which of the following organisms gather between the characteristics of living organisms and non-living things ?
[Choose two answers]
 (a) Plants. (b) Viroids. (c) Fungi.
 (d) Prions. (e) Bacteria.
- 2 Which of the following organisms doesn't(don't) have a level in the taxonomic hierarchy ?
 (a) *Euglena*. (b) *Nostoc*. (c) Prions. (d) *Spirogyra*.
- 3 Which of the following organisms is classified by the scientist Whittaker in the modern classification system ?
 (a) HIV. (b) Malaria *Plasmodium*.
 (c) Prions of mad cow disease. (d) Tomato apical stunt viroid (TASVd).
- 4 ✓ Which of the following pathogens is not classified according to the modern classification system ?
 (a) Sleeping sickness. (b) Malaria disease. (c) Corona disease. (d) Elephantiasis.
- 5 The following diagram illustrates a trial of the classification of living organisms :



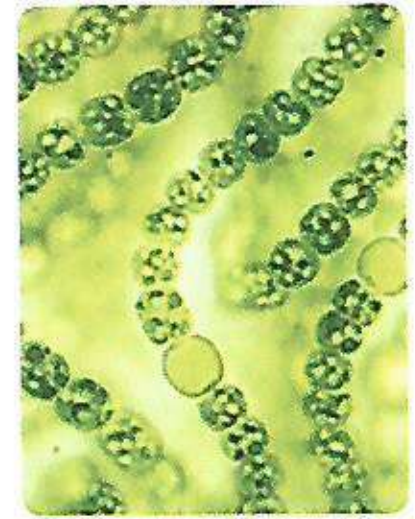
Who is the scientist that established this type of classification ?

- (a) Whittaker. (b) Carolus Linnaeus. (c) Aristotle. (d) Bovary.
- 6 ✓ All monerans are characterized by
 (a) living in definite environments. (b) dividing meiotically and mitotically.
 (c) having a nucleus with a definite shape. (d) dividing mitotically only.

7 From the opposite figure, answer :

(1) Which of the following characteristics is available in the organism shown in the figure ?

- (a) It has a nuclear membrane.
- (b) It has a complex structure.
- (c) It contains chlorophyll pigment.
- (d) Its sex is separated.



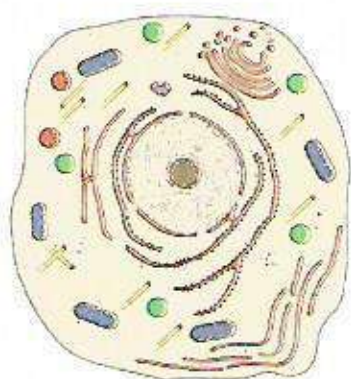
(2) The basic standard in classifying this organism among monerans is

- (a) the number of body cells.
- (b) the type of nucleus.
- (c) the absence of mitochondria.
- (d) the presence of plastids.

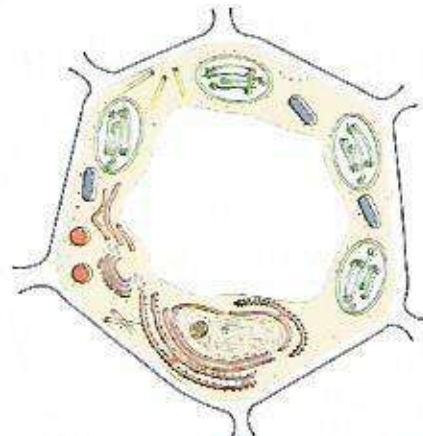
8 "All Archaeobacteria live in the harsh environmental conditions". "The body of all kinds of bacteria is surrounded by a structure that consists of the same materials".

- (a) The first statement is correct and the second statement is wrong.
- (b) The first statement is wrong and the second statement is correct.
- (c) The two statements are correct.
- (d) The two statements are wrong.

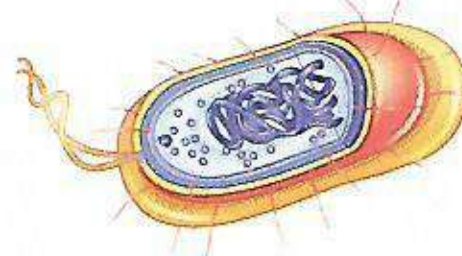
9 The following figures illustrate four cells of different living organisms, which of them belongs to kingdom Monera ?



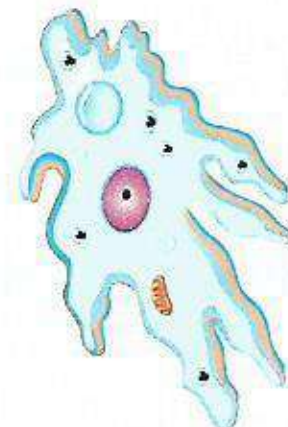
(a)



(b)



(c)



(d)

10 Which of the following organisms doesn't contain a nuclear membrane ?

[Choose two answers]

- (a) *Nostoc*.
- (b) *Euglena*.
- (c) *Trypanosoma*.
- (d) *Amoeba*.
- (e) Spiral-shaped bacteria.

11 When examining two drops of water, one from the sulphur hot spring in Helwan and the other from the fresh water spring at Ain al-siliyin, microscopic organisms were observed in both samples and after examination, it was found that they are different in the composition of the

- (a) cell membrane only.
- (b) cell wall only.
- (c) cell membrane and cell wall.
- (d) nucleus only.

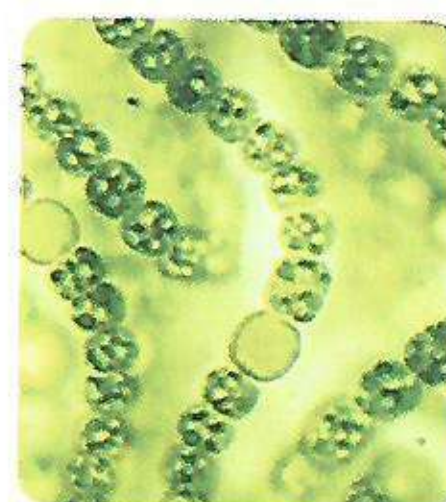
12 Which of the following are from the characteristic features of yogurt bacteria ?

[Choose two answers]

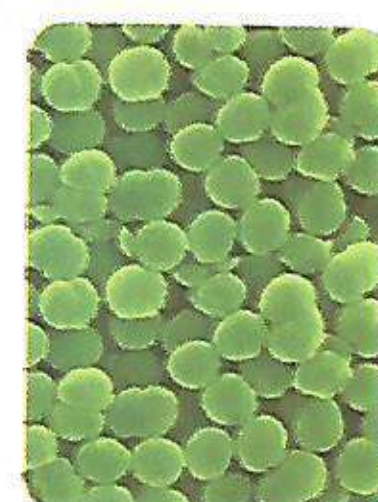
- (a) It can't be seen by naked eye.
- (b) It reproduces asexually by binary fission.
- (c) It is autotrophic.
- (d) It is rich in the membranous organelles.
- (e) It reproduces sexually.

13 Which of the following represents the difference between organisms no. (1) and (2) ?

- (a) The taxonomic group for each of them.
- (b) The type of nucleus.
- (c) The mode of nutrition.
- (d) The cell wall structure.



(1)



(2)

14 All the following are from the characteristic features of phylum Protozoa, except

- (a) the number of body cells.
- (b) that it can't be seen by naked eye.
- (c) that it is autotrophic.
- (d) that it has simple structure.

15 A living organism that is unicellular and has indefinite shape is

- (a) *Amoeba*.
- (b) *Paramecium*.
- (c) *Plasmodium*.
- (d) *Trypanosoma*.

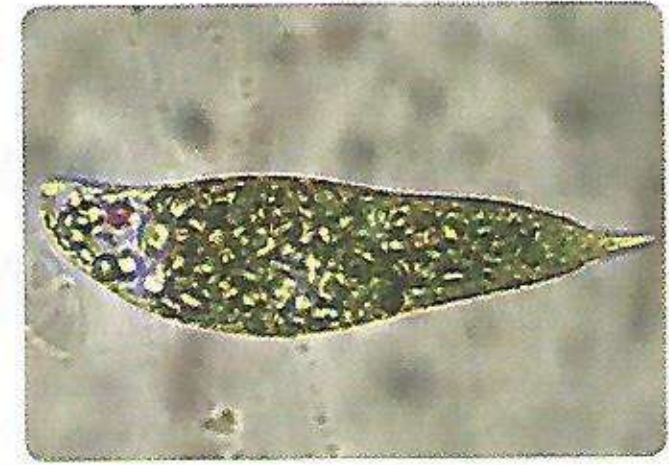
16 Bacteria, *Paramecium* and *Euglena* are a group of unicellular organisms. Which of the following represents the suitable dichotomous key for these organisms ?

- (a) Unicellular organisms —
 - have a definite nucleus → Bacteria
 - don't have a definite nucleus → *Euglena* - *Paramecium*
- (b) Unicellular organisms —
 - have a definite nucleus → *Euglena* - *Paramecium*
 - don't have a definite nucleus → Bacteria
- (c) Unicellular organisms —
 - have cellulose in the cell wall → Bacteria
 - don't have cellulose in the cell wall → *Euglena* - *Paramecium*
- (d) Unicellular organisms —
 - have plastids → Bacteria - *Paramecium*
 - don't have plastids → *Euglena*

17 From the opposite figure :

(1) This organism shares *Trypanosoma* in

- (a) the mode of living.
- (b) the mean of locomotion.
- (c) the mode of nutrition.
- (d) its effect on the human health.



(2) This organism differs from plants in the

- (a) presence of nucleus.
- (b) mode of nutrition.
- (c) presence of a mean of locomotion.
- (d) presence of pigments.

(3) Most of the kingdom to which this organism belongs is characterized by

- (a) being unicellular.
- (b) containing green plastids.
- (c) moving by flagella.
- (d) being autotrophic.

18 The reason that scientist Whittaker had put *Amoeba*, *Paramecium* and *Euglena* in one kingdom is

- (a) the structure of the body.
- (b) the mean of locomotion.
- (c) the method of reproduction.
- (d) the mode of nutrition.

19 The standard that makes scientist Whittaker put *Euglena* and *Nostoc* in two different taxonomic groups is

- (a) the difference in the mode of living.
- (b) the presence of plastids.
- (c) the number of body cells.
- (d) the type of nucleus.

20 *Trypanosoma* and *Plasmodium* are different in [Choose two answers]

- (a) the mode of nutrition.
- (b) the phylum they both belong to.
- (c) the type of nucleus.
- (d) the mean of locomotion.
- (e) the class they both belong to.

21 *Euglena* and dinoflagellates are similar in all the following, except

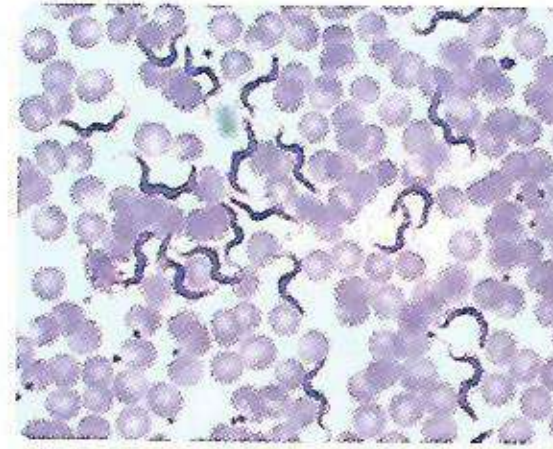
- (a) the number of body cells.
- (b) the mode of nutrition.
- (c) the mean of locomotion.
- (d) the type of pigments.

22 Which of the following are from the autotrophic protists [Choose two answers]

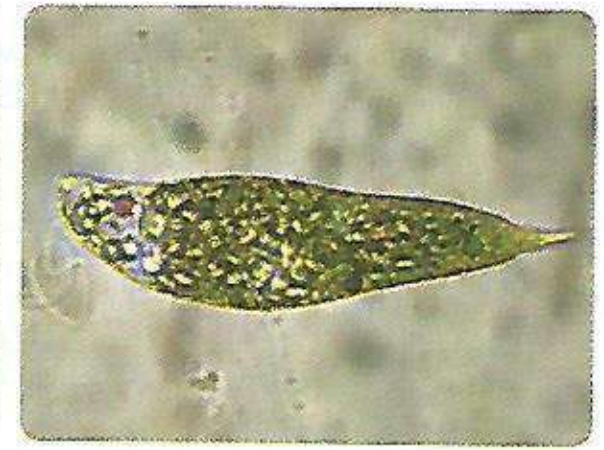
- (a) dinoflagellate.
- (b) *Paramecium*.
- (c) *Plasmodium*.
- (d) *Trypanosoma*.
- (e) *Euglena*.

23 Which of the following characteristics is different in organisms (A) and (B) ?

- (a) The kingdom they both belong to.
- (b) The number of body cells.
- (c) The mode of nutrition.
- (d) The mean of locomotion.



(A)



(B)

24 Which of the following organisms has/have plastids in its/their cytoplasm ?

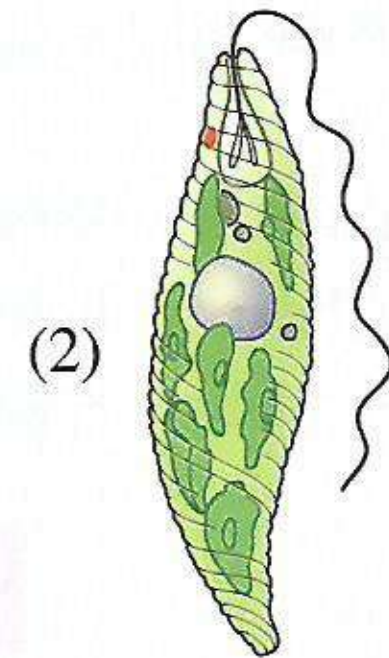
- (a) Archaeobacteria.
- (b) *Euglena*.
- (c) *Plasmodium*.
- (d) *Paramecium*.

25 Which dichotomous key is used in identifying organisms no. (1) and (2) ?

- (a) Prokaryotic —
 - mobile —→ (1)
 - fixed —→ (2)
- (b) Unicellular —
 - binucleated —→ (1)
 - mononucleated —→ (2)
- (c) Eukaryotic —
 - unicellular —→ (1)
 - multicellular —→ (2)
- (d) Unicellular —
 - mobile —→ (1)
 - fixed —→ (2)

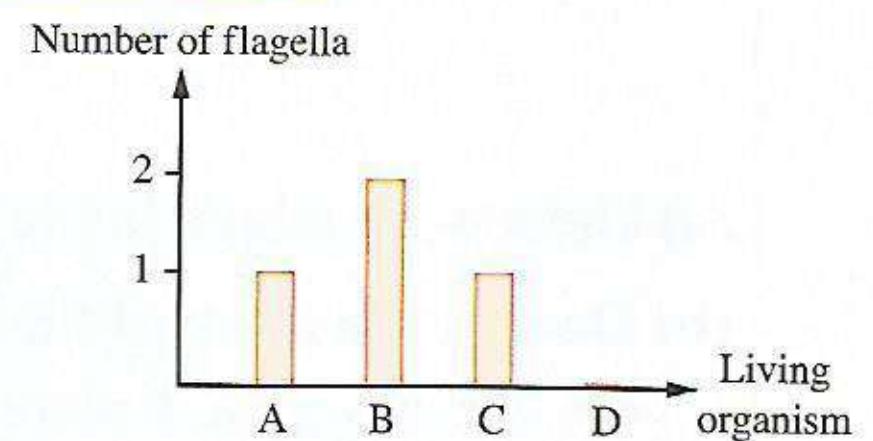


(1)



(2)

26 The opposite graph illustrates four living organisms (A), (B), (C) and (D) and the number of flagella in each of them. Study the graph, then answer :



(1) Which of the following living organisms has red colour ?

- (a) A
- (b) B
- (c) C
- (d) D

(2) Which of the following living organisms causes malaria disease ?

- (a) A
- (b) B
- (c) C
- (d) D

(3) If organisms (A) and (C) belong to the same kingdom, but organism (A) doesn't cause any disease. So, it is expected that organisms (A) and (C) are respectively.

- (a) *Trypanosoma* and *Euglena*
- (b) *Euglena* and *Amoeba*
- (c) *Paramecium* and *Amoeba*
- (d) *Euglena* and *Trypanosoma*

27 The following table illustrates some unicellular organisms :

The living organism	The character
A	Its cell walls are rich in silica.
B	It is autotrophic, mobile and red in colour.
C	It is autotrophic, mobile and has eye spot.

Which of the following living organisms represent (A), (B) and (C) respectively ?

- (a) *Nostoc* / Diatoms / Dinoflagellate.
- (b) Diatoms / *Nostoc* / Dinoflagellate.
- (c) Diatoms / Dinoflagellate / *Euglena*.
- (d) *Nostoc* / Dinoflagellate / *Euglena*.

28 All the following are from the characteristics of diatoms, except that they

[Choose two answers]

- (a) are unicellular organisms.
- (b) are eukaryotic organisms.
- (c) have pectin in their cell walls.
- (d) are marine organisms.
- (e) are heterotrophic organisms.

Second

Miscellaneous Questions

1 Despite the Dead Sea is named after this name, due to the absence of living organisms in it, because it is extremely salty, living organisms were observed in it when examining a sample of the Dead Sea water :

- (a) Determine which living organisms can be seen.
- (b) Deduce the name of the kingdom to which these organisms belong and what are the characteristic features of them ?

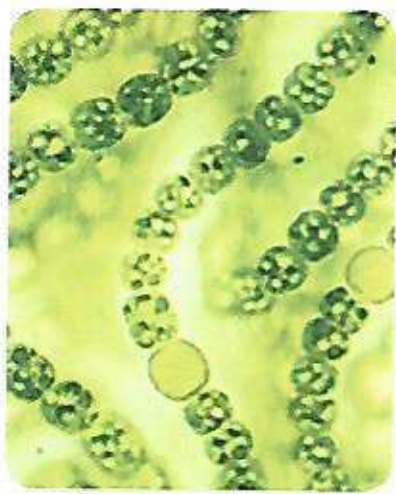
2 In the light of your study for the characteristic features of prokaryotic and eukaryotic cells. The opposite figure represents one of the microscopic organisms that lives in the human alimentary canal. Is the cell of this organism prokaryotic or eukaryotic ? Explain your answer.



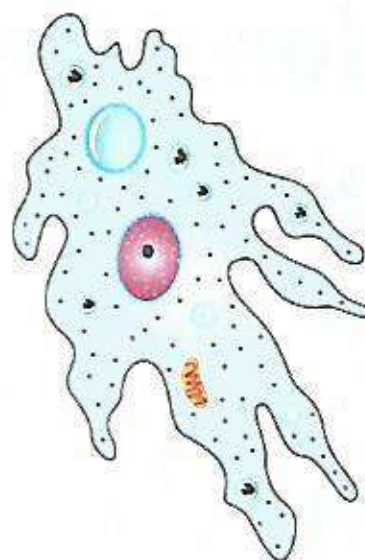
3 "All protozoans are mobile living organisms". How far this statement is correct ? With explanation.

4 What are the similarities and differences between : *Nostoc* and *Amoeba* ?

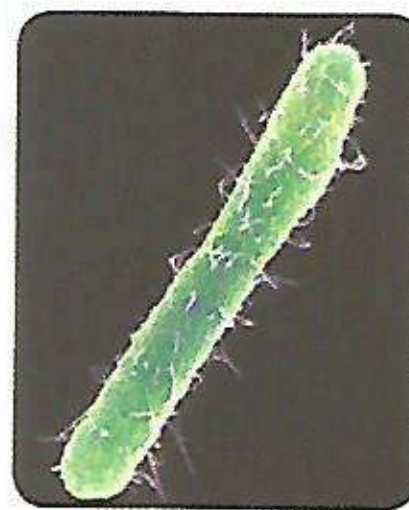
- 5 "Pyrophyta contain red pigment only". **How far this statement is correct ?**
With explanation.
- 6 If you have three slides (*Amoeba* – *Euglena* – *Paramecium*). **How can you identify each one of them ?**
- 7 ✓ "The more diatoms in a lake, the greater income to the fishermen who are fishing from this lake". **How far this statement is correct ? With explanation.**
- 8 ✓ The following figures illustrate some living organisms :



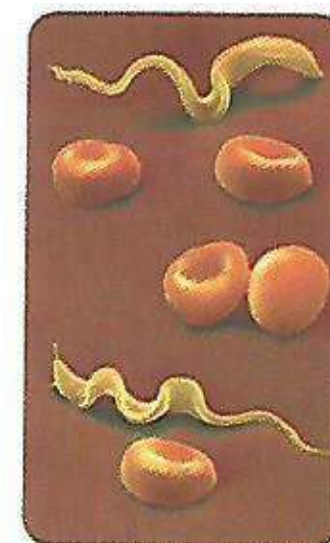
(1)



(2)

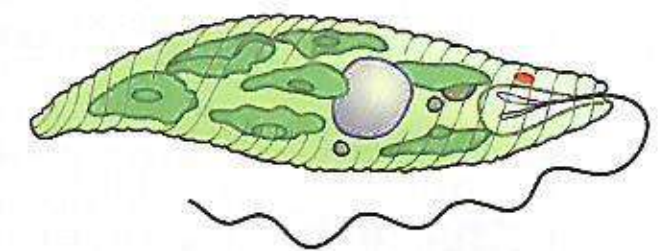


(3)



(4)

- (a) **Determine** the kingdom to which each organism from the previous belongs, according to the traditional classification system.
- (b) **Determine** the similarities between each organism from the previous ones and organism (A).



(A)

- 9 **Give reason for :** diatoms have a great economic importance.



CHAPTER 2

LESSON TWO

- Kingdom Fungi.
- Kingdom Plantae.

Third

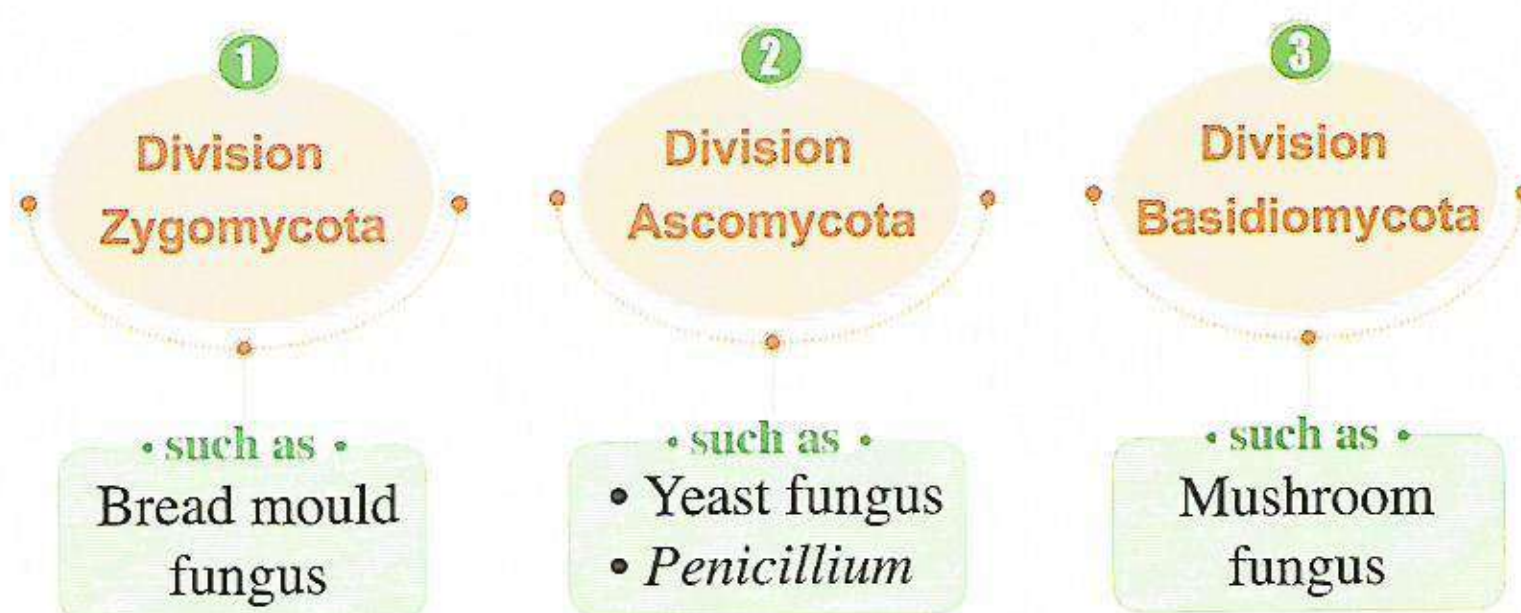
Kingdom Fungi

General characteristics of kingdom Fungi

- **Structure** : some fungi are unicellular and the majority are multicellular composed of filaments called **hyphae** that are collected together to form the **mycelium**.
- **Nucleus** : it is **eukaryotic**.
- **Cell wall** : **lignin** substance enters in its structure.
- **Locomotion** : they are immobile.
- **Nutrition** : they are **heterotrophic**, where some of them are **parasites** and others are **saprophytes**.
- **Reproduction** : the majority reproduce **sexually**, as well as they reproduce **asexually** by producing **spores**.
- **Kingdom Fungi is classified depending on their structure and ways of reproduction into five divisions, the most important ones are :**

Hint

In scientific references, it is mentioned that **chitin** enters in the structure of the cell walls of fungi instead of lignin.



1

Division
Zygomycota :

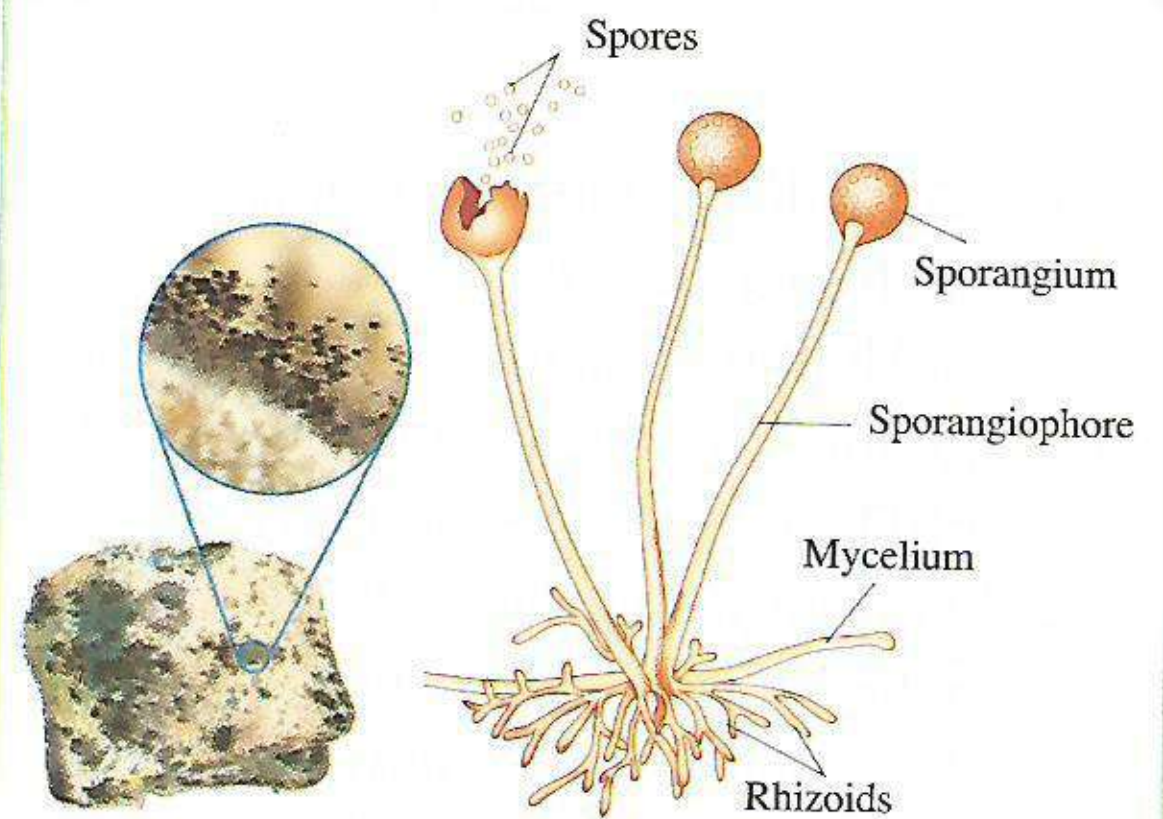


The hyphae are not divided and the spores are produced inside **sporangia**.

Example

Bread mould fungus (*Rhizopus nigricans*) which :

- Causes the black putrefaction on bread.
- An enzyme is extracted from it used in cheese industry.



Bread mould fungus
(*Rhizopus nigricans*)

2

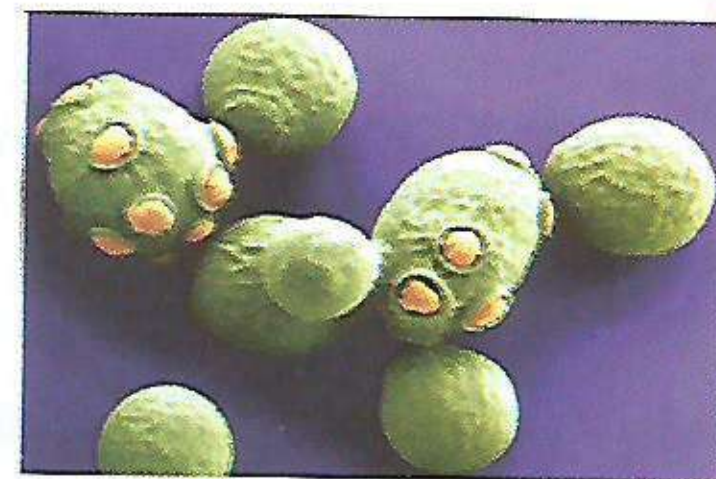
Division
Ascomycota :



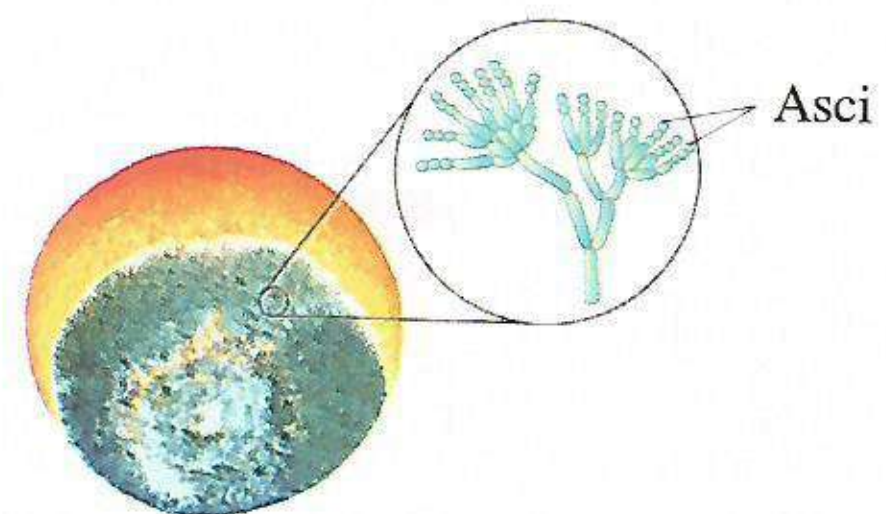
Some of them are unicellular while others are multicellular with hyphae that are divided by **septa**, and the spores are produced inside **sac-like structures called asci**.

Examples

- **Yeast fungus** (unicellular).
- **Penicillium** (multicellular) which produces the antibiotic penicillin.



Yeast fungus



Penicillium

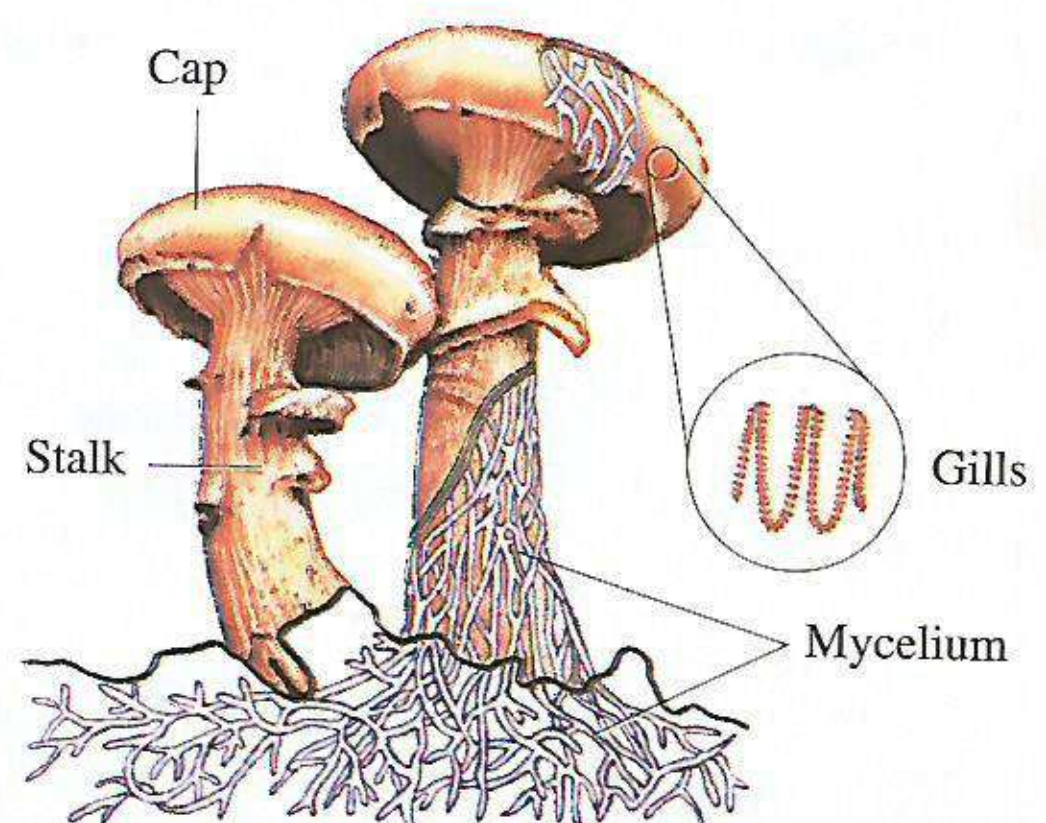
3

Division
Basidiomycota :

The hyphae are divided by septa, and spores are produced inside **a club-shaped structure called basidium**.

Example

Mushroom fungus which some of its types are used as human food.



Mushroom fungus

1 Test yourself

Answered

Choose the correct answer :

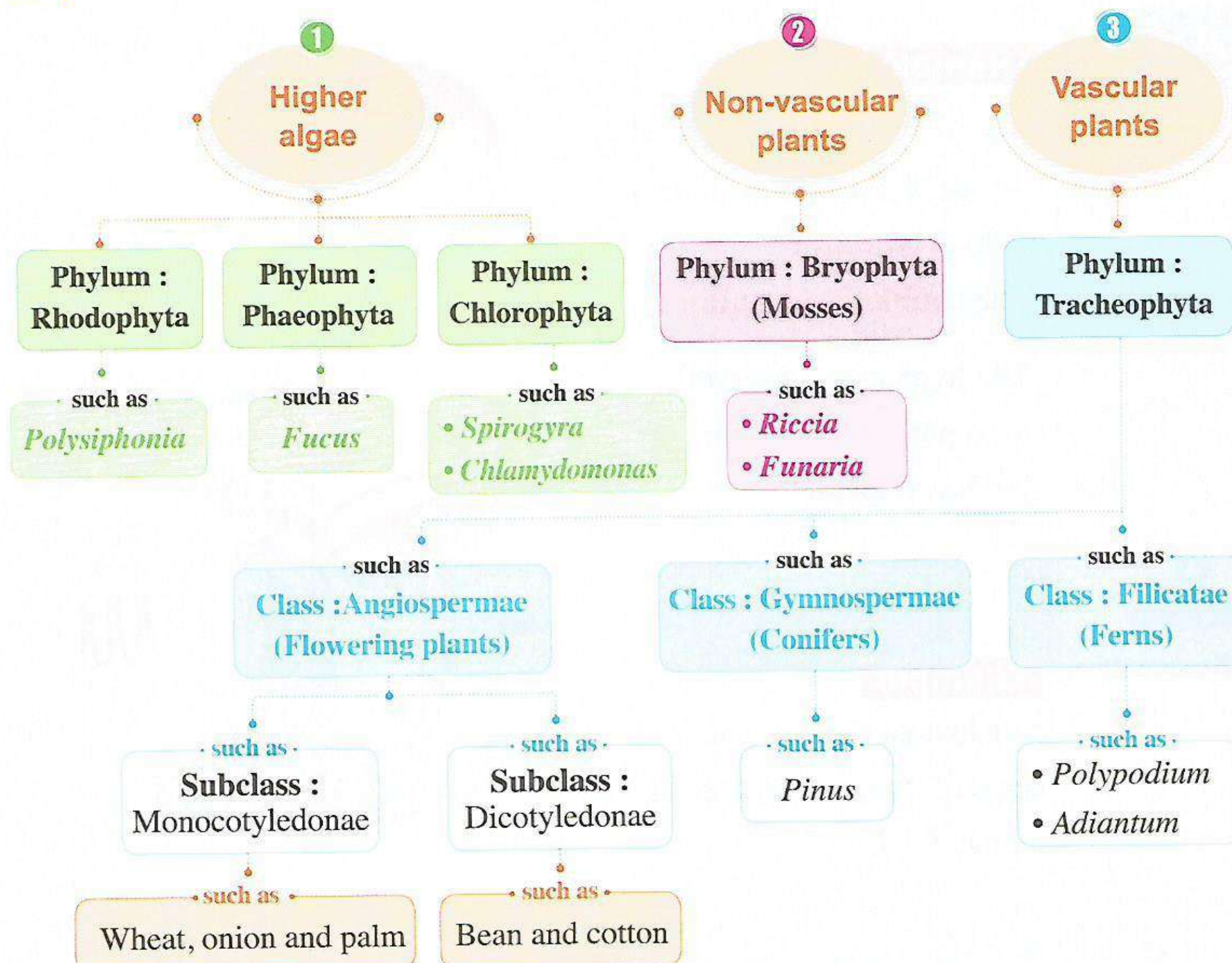
- (1) "The cells of mushroom fungus contain chlorophyll pigment". "Some types of it are used as human food".
- (a) The first statement is correct and the second statement is wrong.
 (b) The first statement is wrong and the second statement is correct.
 (c) The two statements are correct. (d) The two statements are wrong.
- (2) Yeast fungus is similar to *Penicillium* in all the following, except
- (a) reproduction by spores. (b) the hyphae shape.
 (c) the substance forming the cell wall. (d) the nutrition mode.

Fourth

Kingdom Plantae



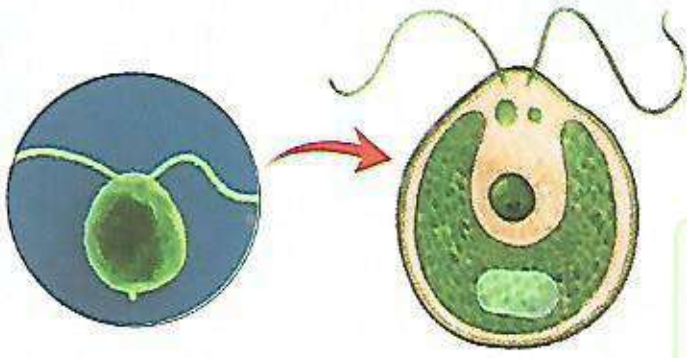

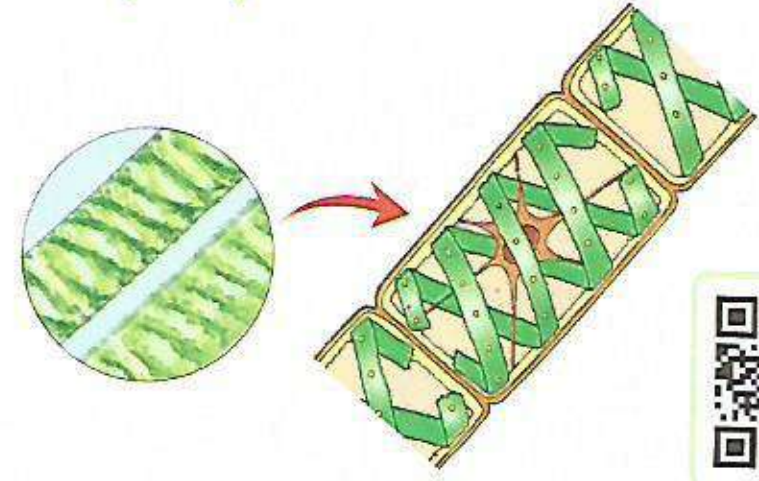

General characteristics of kingdom Plantae

- **Nucleus** : it is eukaryotic.
- **Cell wall** : it consists of cellulose.
- **Cytoplasm** : it contains chloroplasts (green plastids) that contain chlorophyll substance.
- **Reproduction** : the majority reproduce sexually.
- **Kingdom Plantae is classified into three groups, as follows :**



1 Higher algae

- The higher algae include three phyla :

<p>① Phylum Rhodophyta :</p>	<ul style="list-style-type: none"> They are marine weeds that consist of filaments sticking together by a gelatinous coat. Their cells contain chromatophores of red pigments. So, they are called red algae. <p>Example <i>Polysiphonia</i> alga</p>	 <p><i>Polysiphonia</i></p>
<p>② Phylum Phaeophyta :</p>	<ul style="list-style-type: none"> They are marine weeds that consist of simple or branched filaments. Their cells contain chromatophores of brown pigments. So, they are called brown algae. <p>Example <i>Fucus</i> alga</p>	 <p><i>Fucus</i></p>
<p>③ Phylum Chlorophyta :</p>	<ul style="list-style-type: none"> Some of them are unicellular while others are multicellular. Their cells contain chloroplasts. So, they are called green algae. <p>Examples</p> <ul style="list-style-type: none"> <i>Chlamydomonas</i> alga (unicellular) : it contains a cup-shaped plastid. <i>Spirogyra</i> alga (multicellular) : it takes the form of unbranched filaments and its cells contain spiral-shaped plastids. <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p><i>Chlamydomonas</i> alga</p> </div> <div style="text-align: center;">  </div> <div style="text-align: center;">  <p><i>Spirogyra</i> alga</p> </div> <div style="text-align: center;">  </div> </div>	

2 Test yourself

Answered

- ① "The more the living organism becomes advanced, the more cells it has".
How far this statement is correct ? With explanation.

.....

.....

.....

.....

.....

- ② There are two organisms (A) and (B), both of them are marine eukaryotic autotrophic organisms and contain red pigments, but organism (A) is characterized by being phytoplankton, while organism (B) is from marine weeds, according to your study, mention :

(1) The name of organisms (A) and (B).

.....

(2) The other differences between organisms (A) and (B).

Organism (A)	Organism (B)
.....
.....

2 Non-vascular plants

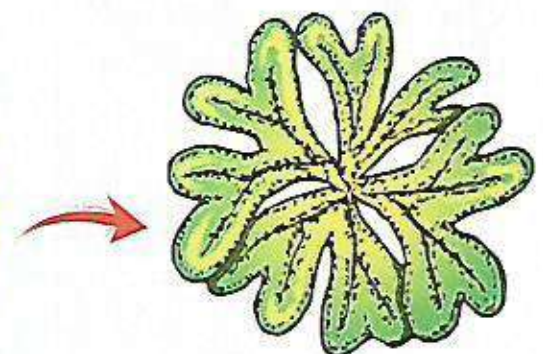
- They are plants that don't contain vascular tissues which are specialized in transporting water or food. So, they are called non-vascular plants and represented by :

Phylum Bryophyta (Mosses)

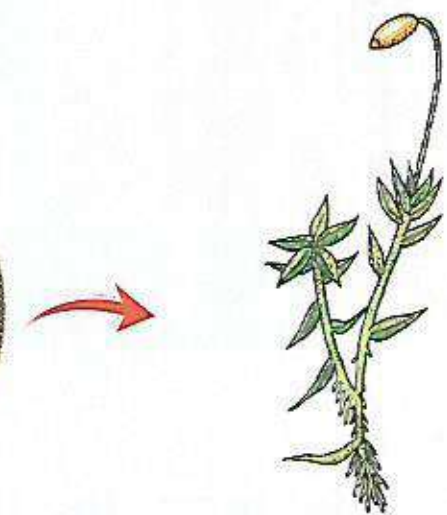
- They are terrestrial plants that live in damp soils and shaded places, because they need high dampness to grow and reproduce.
- They are small-sized plants, green in colour and have hairs for anchorage (rhizoids).

Examples

- *Riccia* which is flat.
- *Funaria* which is erect.



Riccia




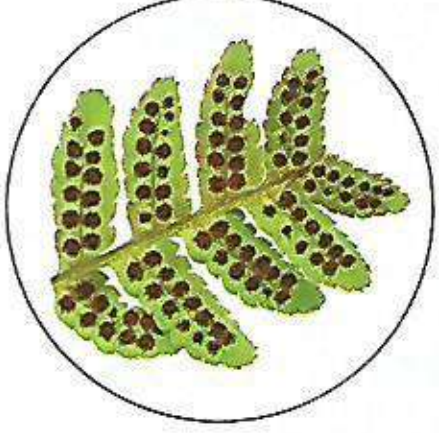



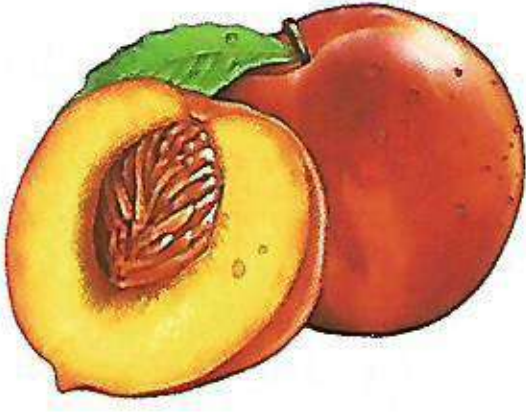
Funaria

3 Vascular plants


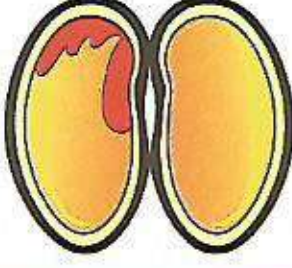
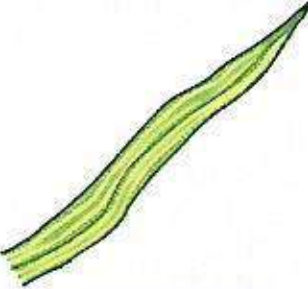
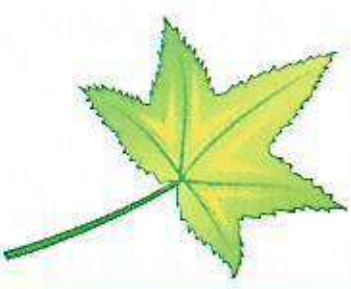

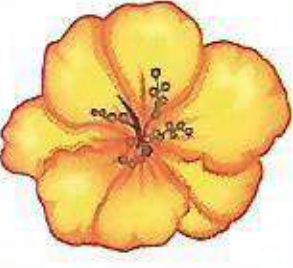
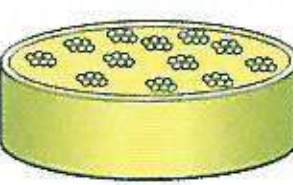


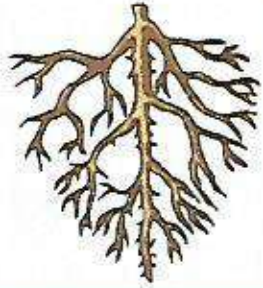
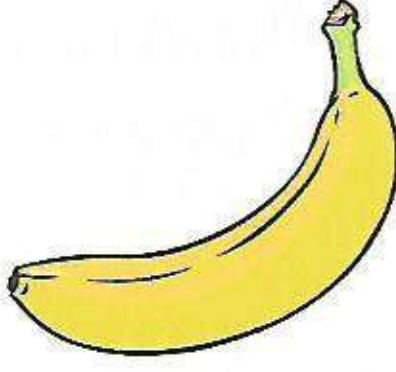
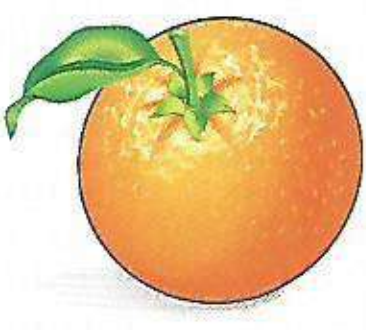
- They are plants that contain specialized vascular tissues for transportation, which are :
 - **Xylem** which transports water and mineral salts from root to stem, then to leaves.
 - **Phloem** which transports the organic substances that are formed during photosynthesis process from leaves to all the plant parts. So, they are called **vascular plants**.

Phylum Tracheophyta

• Phylum Tracheophyta is classified into three classes, which are :

<p>1</p> <p>Class</p> <p>Filicatae</p> <p>(Ferns) :</p> 	<ul style="list-style-type: none"> • They are simple-structured plants, where most of them are herbs and few are shrubs or trees. • They have stems, leaves and roots. • They live in shaded-damp places, such as the walls of wells and shaded-damp valleys. • They carry pinnate leaves. • They don't produce flowers or seeds. • They reproduce asexually by spores that are found in special structures on the lower surface of leaves. <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p>A pinnate leaf of <i>Polypodium</i></p> <p><i>Polypodium</i></p> <p>Examples</p> <p>- <i>Polypodium</i> - <i>Adiantum</i></p>
<p>2</p> <p>Class</p> <p>Gymnospermae</p> <p>(Conifers) :</p> 	<ul style="list-style-type: none"> • Most of these plants are trees and few are shrubs. • They carry simple needle-shaped leaves. • They carry male and female cones. • They don't form flowers (non-flowering plants). • They produce naked seeds (without coat "pericarp"). So, they are called by Gymnospermae. • They reproduce sexually. <p>Example</p> <p>- <i>Pinus</i></p>  <p><i>Pinus</i></p>
<p>3</p> <p>Class</p> <p>Angiospermae</p> <p>(Flowering plants) :</p>	<ul style="list-style-type: none"> • They are terrestrial plants that have stems, leaves and roots. • They carry leaves with parallel or palmate venation. • They produce flowers that change into fruits which enclose the seeds. • They reproduce sexually. • They are classified into two groups (subclasses), which are : <ul style="list-style-type: none"> - Monocotyledons. - Dicotyledons.  <p>A fruit of a flowering plant (peach)</p>

• Class Angiospermae is classified into two groups (subclasses), which are :

Taxonomic characteristics	Subclass Monocotyledons	Subclass Dicotyledons
Seeds :	<ul style="list-style-type: none"> One cotyledon. 	<ul style="list-style-type: none"> Two cotyledons. 
Leaves :	<ul style="list-style-type: none"> Leaves are narrow. Parallel-veined. 	<ul style="list-style-type: none"> Palmate or pinnate-veined. 
Flowers :	<ul style="list-style-type: none"> With trimerous whorls or their multiples. 	<ul style="list-style-type: none"> With tetramerous or pentamerous whorls or their multiples. 
Stem :	<ul style="list-style-type: none"> Bundles of vascular tissues are scattered inside the stem. 	<ul style="list-style-type: none"> Bundles of vascular tissues are arranged in a ring inside the stem. 
Roots :	<ul style="list-style-type: none"> Fibrous. 	<ul style="list-style-type: none"> Tap. 
Examples :	<ul style="list-style-type: none"> Wheat, maize, banana, onion, cactus, lily and palm. 	<ul style="list-style-type: none"> Pea, bean, orange, rose and cotton. 

3 Test yourself

Answered

Choose the correct answer :

(1) In a field trip to an egyptian village, a student found a green plant containing stem, leaves and roots. After examination, he found swollen structures full with spores on the lower surface of its leaves. So, what do you expect this plant will be ?

- (a) *Funaria*. (b) *Adiantum*. (c) *Riccia*. (d) *Pinus*.

(2) The following table illustrates some structures in 4 different plants, examine it, then answer :

The structure The plant	Flowers	Seeds	Xylem vessels	Fruits
(1)	✓	✓	✓	✓
(2)	✗	✓	✓	✗
(3)	✗	✗	✓	✗
(4)	✗	✗	✗	✗

1. Which plant may represent *Riccia* ?

- (a) (1). (b) (2). (c) (3). (d) (4).

2. Which plant may represent bean plant ?

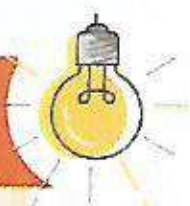
- (a) (1). (b) (2). (c) (3). (d) (4).

3. Which plant may represent *Pinus* ?

- (a) (1). (b) (2). (c) (3). (d) (4).

4. Which plant may represent *Polypodium* ?

- (a) (1). (b) (2). (c) (3). (d) (4).



Practical Activity 3

Examining ferns :



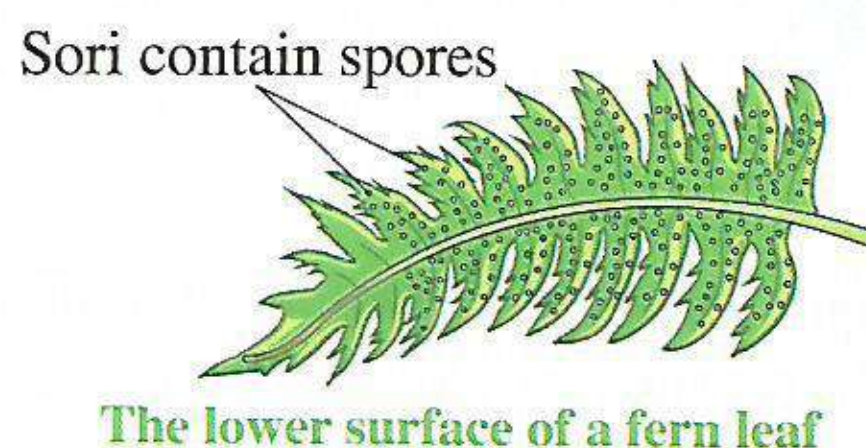
1. Used materials and tools :

- Fern plant. - Hand lens. - Water. - Plastic dropper.

2. Procedures :

- Examine the upper and lower surfaces of the fern plant leaf by using the hand lens.
- Sketch the fern leaf with illustrating the structures that are found on its lower surface.

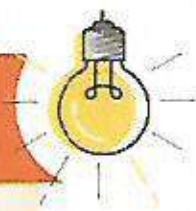
3. Drawing :



4. Conclusion :

- The following table shows the structural characters of the fern leaf :

Leaf shape	Pinnate shape.
The upper surface of the leaf	Smooth and contains no sori.
The lower surface of the leaf	Rough, because it contains many sori which contain spores.



Practical Activity 4

Examining a flowering plant :

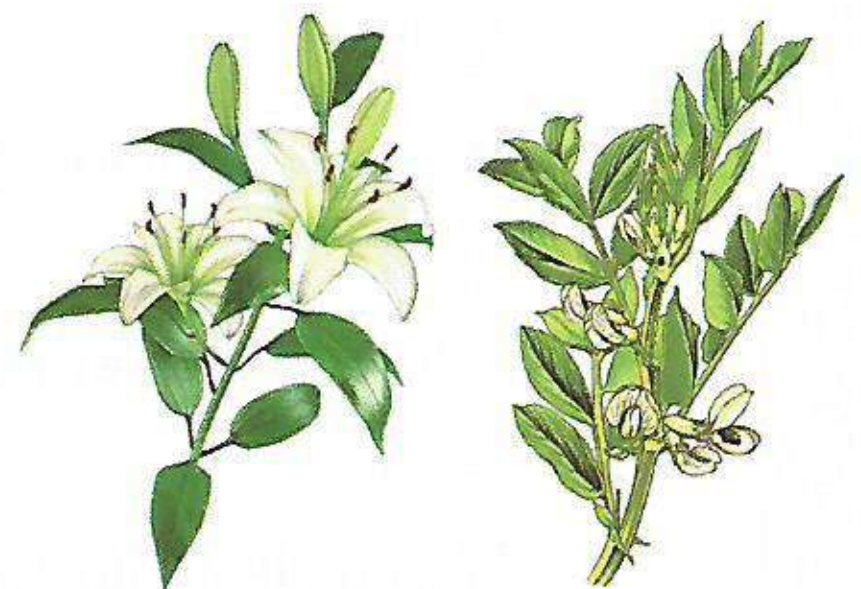
1. Used materials and tools :

- Flowering bean plant.
- Flowering lily plant.
- Hand lens.

2. Procedures :

- Examine the plant parts by using the hand lens.
- Observe the different parts that form the flowering plant.
- Sketch the plant and label the names of its parts.

3. Observations :

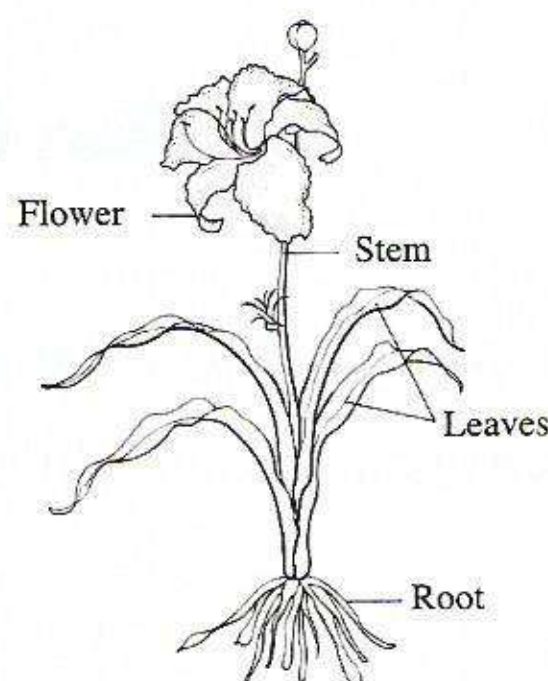


Lily plant

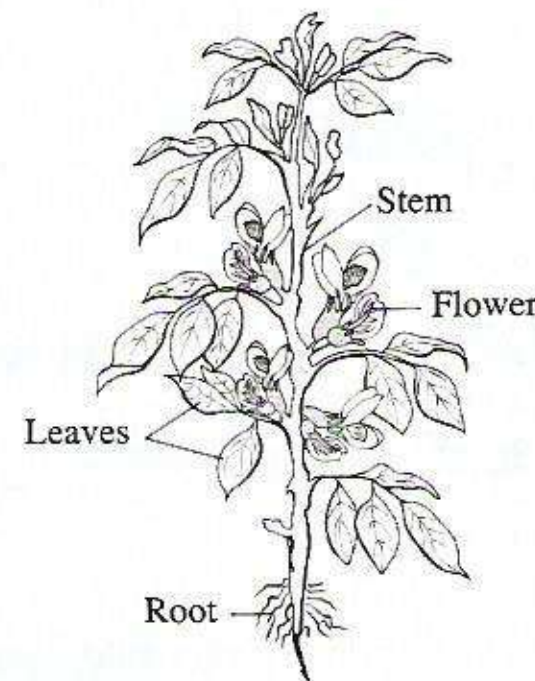
Bean plant

P.O.C.	Roots	Leaves	No. of floral whorls
Plant			
Bean plant	Tap root.	Palmate-veined.	Pentamerous.
Lily plant	Fibrous roots.	Parallel-veined.	Hexamerous (3 in each whorl).

4. Drawing :



Lily plant



Bean plant


5. Conclusion :

Flowering plants share the main parts which are the stem, leaves, roots and the flowers that change into fruits which contain seeds, but don't share the same external shape, because the monocotyledonous plants (lily) differ from the dicotyledonous plants (bean) in the shape of roots, leaves and floral whorls.

• Kingdom Fungi.
• Kingdom Plantae.



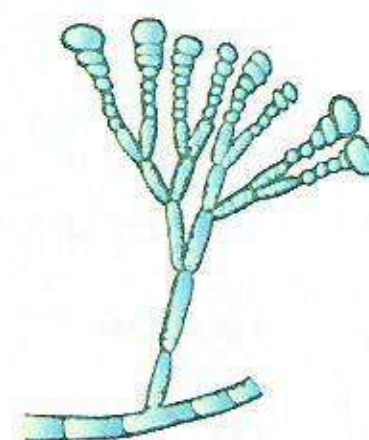
Interactive test

The questions signed by  measure the high levels of thinking.

First

Multiple Choice Questions

- 1 All organisms that consist of hyphae are
 (a) parasitic. (b) unicellular. (c) prokaryotic. (d) multicellular.
- 2 All the following fungi consist of hyphae, except
 (a) bread mould fungus. (b) yeast fungus.
 (c) *Penicillium*. (d) mushroom fungus.
- 3 When leaving a piece of bread in a warm place for several days, is formed.
 (a) multicellular basidiomycete (b) multicellular zygomycete
 (c) unicellular ascomycete (d) multicellular ascomycete
- 4 From the opposite figure :
 (1) The structure of the cell wall of this organism consists of
 (a) silica. (b) pectin.
 (c) chitin. (d) lignin.
 (2) This organism reproduces asexually by
 (a) budding. (b) producing spores.
 (c) regeneration. (d) binary fission.
- 5 All the following living organisms have nuclear membrane, except
 (a) *Penicillium*. (b) *Amoeba*.
 (c) bacteria. (d) bread mould fungus.
- 6 There are many multicellular saprophytic living organisms cause food spoilage and they are used in some food industries, in the light of your study, answer :
 (1) These organisms belong to kingdom
 (a) Monera. (b) Protista. (c) Fungi. (d) Plantae.
 (2) All the following characterize these organisms, except that
 (a) they reproduce sexually. (b) they reproduce asexually.
 (c) they are eukaryotic. (d) they are able to move.



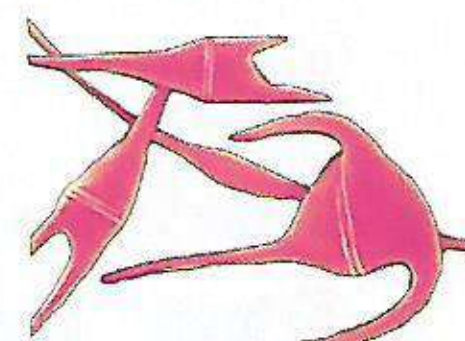
- 7 Algae live as organisms.
- (a) parasitic (b) predator (c) free-living (d) saprophytic

- 8 Which of the following organisms don't produce spores ?
- (a) *Plasmodium*. (b) *Penicillium*.
(c) *Polysiphonia*. (d) Mushroom fungus.

- 9 The opposite two figures represent two different marine organisms, study them, then answer :



(A)

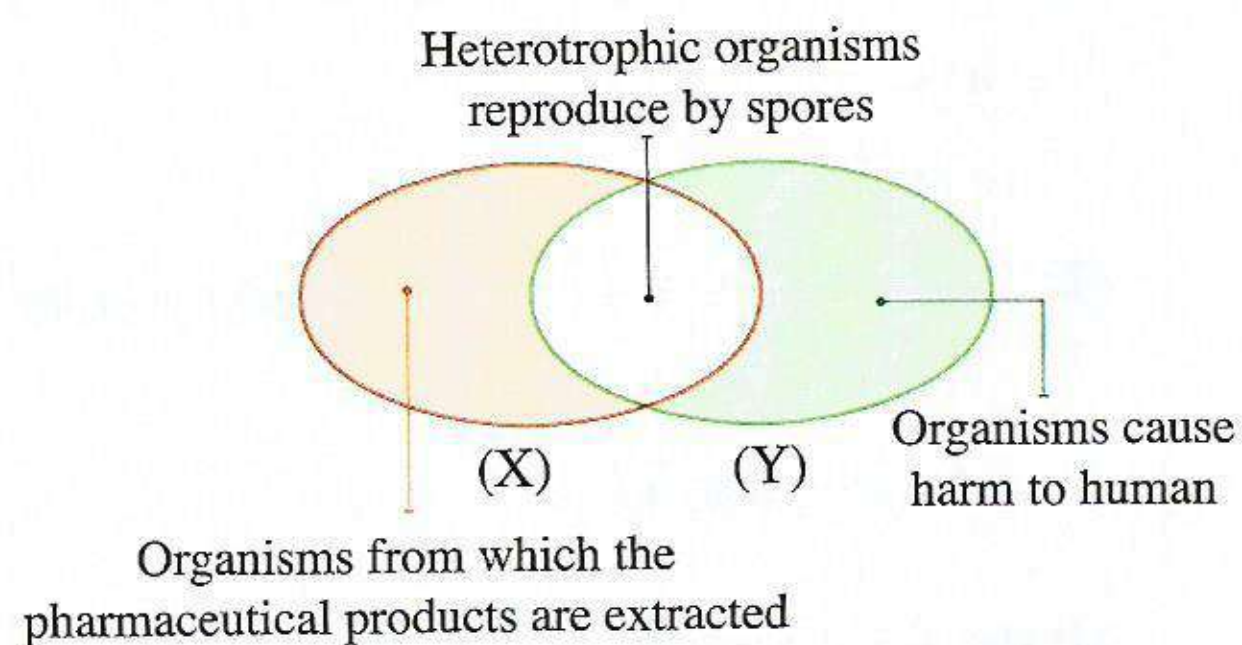


(B)

- (1) The taxonomic standard of the opposite two organisms are determined according to
- (a) the structure of the body. (b) the colour of pigments.
(c) the mode of nutrition. (d) the presence of nucleus.
- (2) Organism (A) shares organism (B) in all the following, except the
- (a) mode of nutrition. (b) habitat.
(c) nucleus components. (d) mean of locomotion.

- 10 From the opposite figure, we deduce that organisms (X) and (Y) are respectively.

- (a) *Penicillium* and yeast fungus
(b) mushroom and bread mould fungus
(c) bread mould fungus and *Trypanosoma*
(d) *Penicillium* and *Plasmodium*



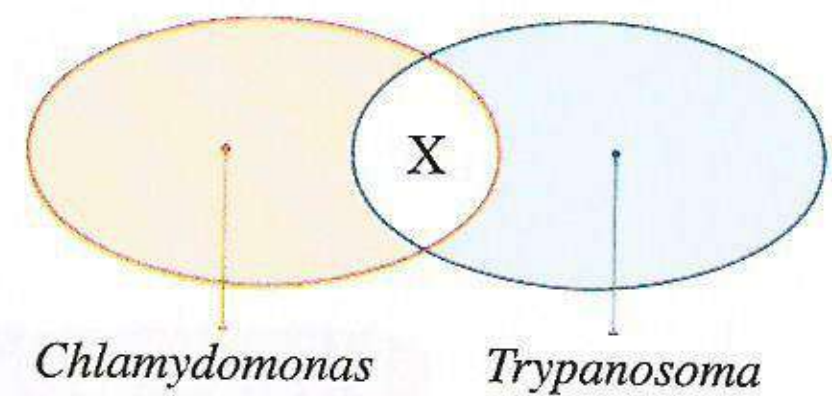
- 11 From the opposite figure :

- (1) This organism belongs to
- (a) terrestrial plants. (b) marine weeds.
(c) vascular plants. (d) Filicatae (ferns).
- (2) This organism contains pigment(s).
- (a) red and green (b) red or green
(c) red only (d) green only
- (3) This organism shares dinoflagellate in
- (a) being prokaryotic. (b) the habitat.
(c) containing flagella. (d) having glass-like walls.



12 From the opposite figure, letter (X) refers to

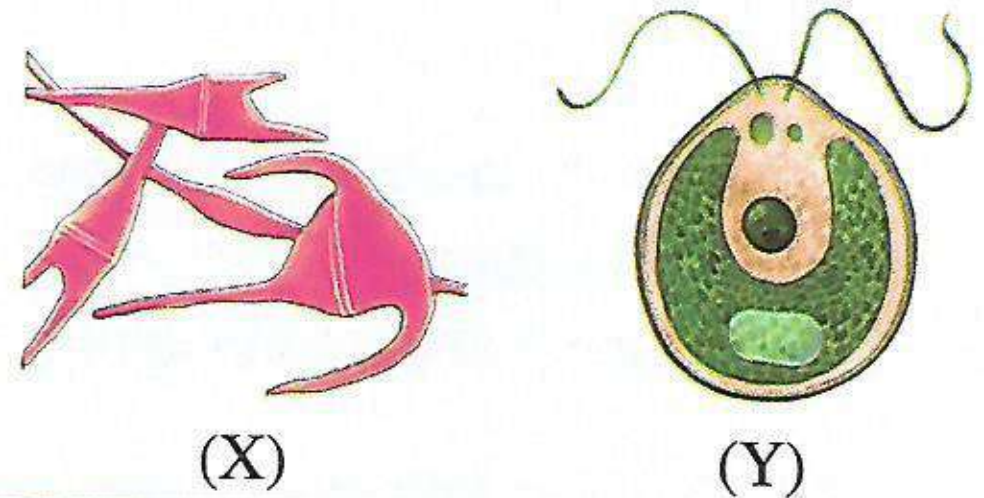
- (a) the mode of nutrition.
- (b) the mean of locomotion.
- (c) the taxonomic level.
- (d) the habitat.



13 Which of the following are from the differences between organism (X) and organism (Y) ?

[Choose two answers]

- (a) The presence of true nucleus.
- (b) The presence of chlorophyll pigment.
- (c) The mean of locomotion.
- (d) The phylum they both belong to.
- (e) The kingdom they both belong to.



14 Study the characteristics of the following organisms, then answer :

- **Organism (1)** consists of filaments sticking together by a gelatinous coat.
- **Organism (2)** consists of branched filaments and it is a marine weed.
- **Organism (3)** consists of unbranched filaments.

(1) The phyla that include these organisms are respectively.

- (a) Rhodophyta - Pyrrophyta - Chlorophyta
- (b) Pyrrophyta - Rhodophyta - Phaeophyta
- (c) Rhodophyta - Phaeophyta - Chlorophyta
- (d) Pyrrophyta - Chlorophyta - Phaeophyta

(2) All the following are from the similarities between organism (1) and organism (3), except

- (a) the nucleus structure.
- (b) the body structure.
- (c) the types of pigments.
- (d) the mode of nutrition.

15 *Chlamydomonas* alga share *Euglena* in all the following, except

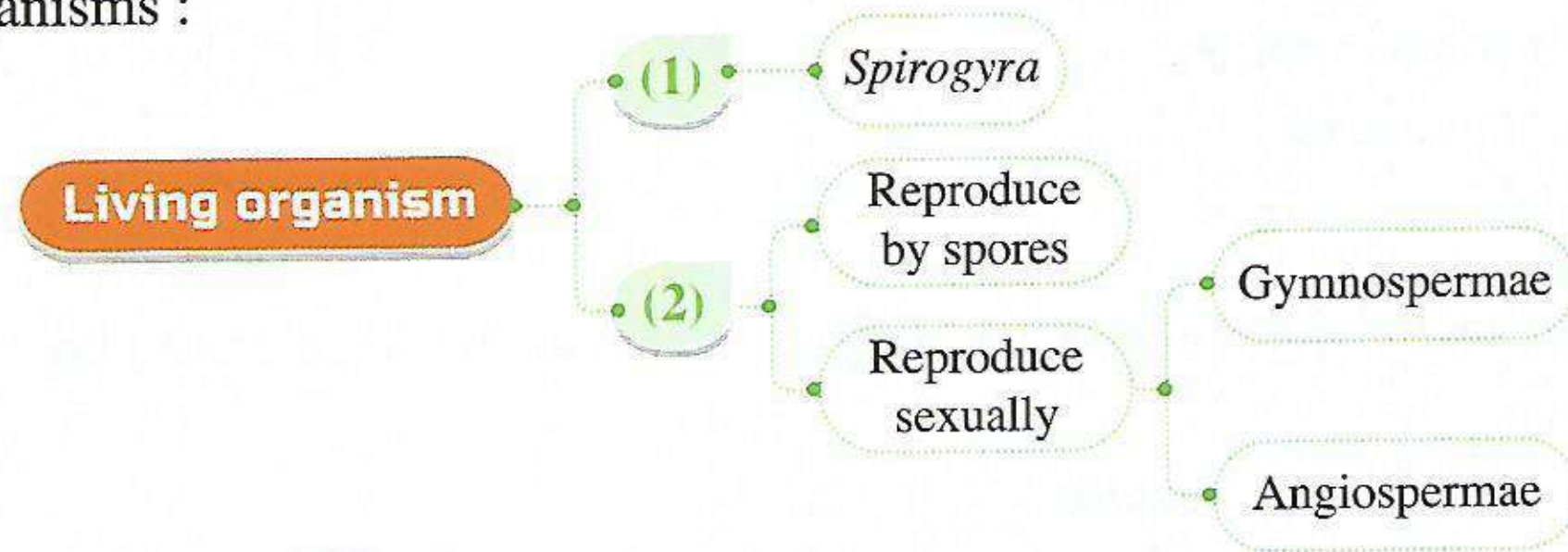
[Choose two answers]

- (a) the number of cells.
- (b) the mode of nutrition.
- (c) the number of green plastids.
- (d) the mean of locomotion.
- (e) the phylum they both belong to.

16 All the following may be used in the differentiation between *Chlamydomonas* and *Spirogyra*, except

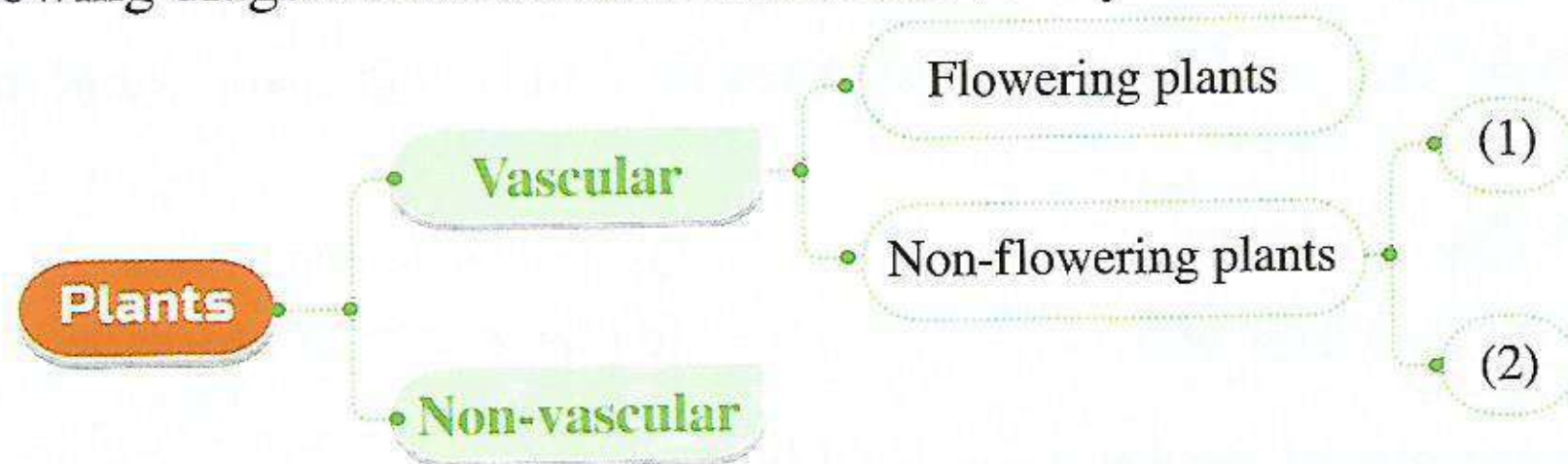
- (a) that one of them is unicellular and the other is multicellular.
- (b) the shape of plastids in each of them.
- (c) that one of them is filamentous in shape and the other is non-filamentous.
- (d) the cell wall structure.

- 17 The following diagram illustrates a design of a bilateral dichotomous key for a group of living organisms :



What is the standard used in the classification of no. (1) and no. (2) ?

- (a) The nutrition. (b) Seeds formation.
(c) The method of reproduction. (d) The structure of the body.
- 18 Which of the following doesn't contain xylem vessel ?
(a) *Pinus*. (b) Bean plant. (c) *Polypodium*. (d) *Funaria*.
- 19 Which of the following organisms is less advanced in the modern classification system ?
(a) *Riccia*. (b) *Polypodium*. (c) *Polysiphonia*. (d) Cactus.
- 20 A non-flowering plant that differentiates into male or female is
(a) palm plant. (b) pea plant. (c) *Pinus*. (d) *Adiantum*.
- 21 ✓ The following diagram illustrates a dichotomous key :

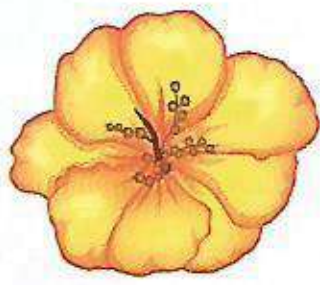


Which of the following statements is correct to identify no. (1) and no. (2) ?

[Choose two answers]

- (a) Has parallel-veined leaves. (b) Has tap roots.
(c) Form seeds inside pericarp. (d) Has needle-shaped leaves.
(e) Has pinnate-veined leaves.
- 22 The parallel venation of leaves is a characteristic feature for the plant that
(a) doesn't form flowers or seeds.
(b) doesn't form flowers, but forms seeds.
(c) has fibrous roots.
(d) has bundles of vascular tissues arranged in a ring inside its stem.

- 23 The tap roots is a characteristic feature for the plant that
- carries male and female cones.
 - has no vascular tissues.
 - has flowers with tetramerous whorls or their multiplies.
 - has flowers with trimerous whorls or their multiplies.
- 24 All the following are from the characteristics of *Pinus* plant, except
- the presence of vascular tissues.
 - that the seeds are coated with pericarp.
 - the presence of two types of gametes.
 - that the leaves are simple with needle shape.
- 25 We can deduce that the plant is from class Angiospermae through the examination of the
- flower colour.
 - flower size.
 - flower structure.
 - flower position.
- 26 The following figures illustrate four flowers of different plants, which of these flowers belongs to subclass Monocotyledons ?



(a)



(b)



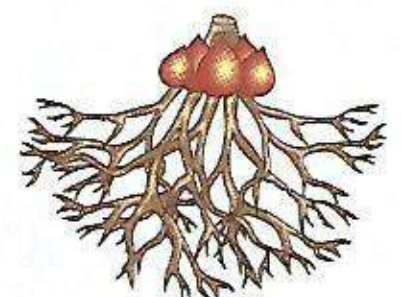
(c)



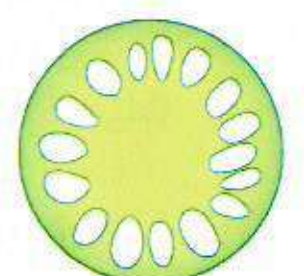
(d)

- 27 Which of the following living organisms reproduce by spores ?
- Bacteria only.
 - Fungi only.
 - All fungi and plants.
 - All fungi and some plants.
- 28 Which of the following plants contain vascular tissue and not differentiated into male or female ?
- Riccia*.
 - Polypodium*.
 - Polysiphonia*.
 - Pinus*.

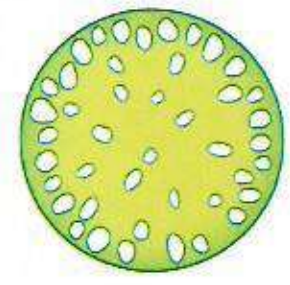
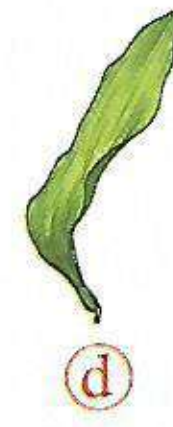
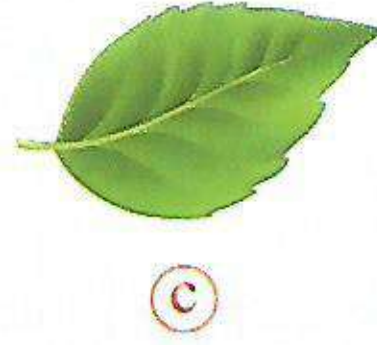
- 29 The flowers of the opposite plant roots have whorls.
- dimerous
 - trimerous
 - tetramerous
 - pentamerous



- 30 On examining the stem of the plant illustrated in the opposite figure, we can deduce that this plant is
- non-vascular.
 - non-flowering.
 - containing cones.
 - containing seeds.



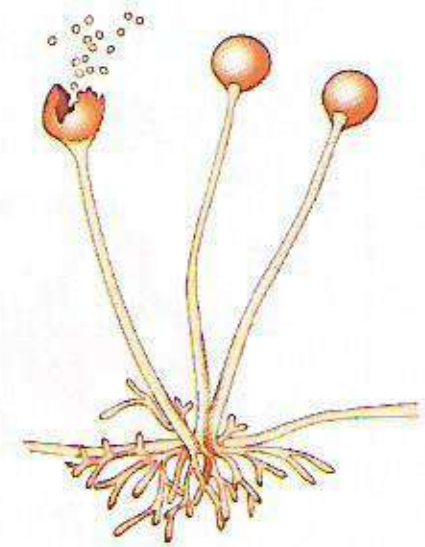
- 31 On examining the stem of the plant illustrated in the opposite figure, we can deduce that it may be from the components of plant



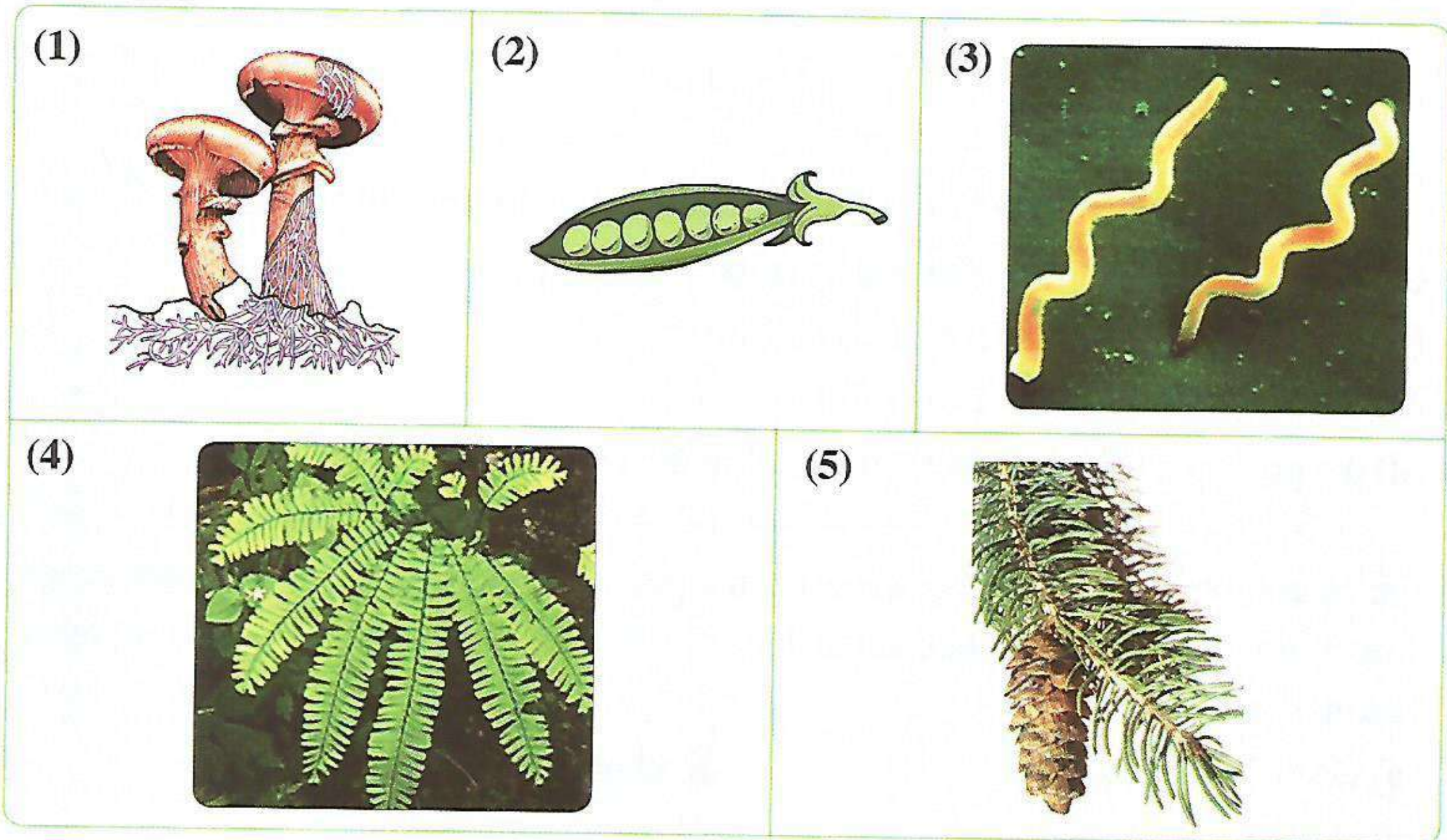
Second

Miscellaneous Questions

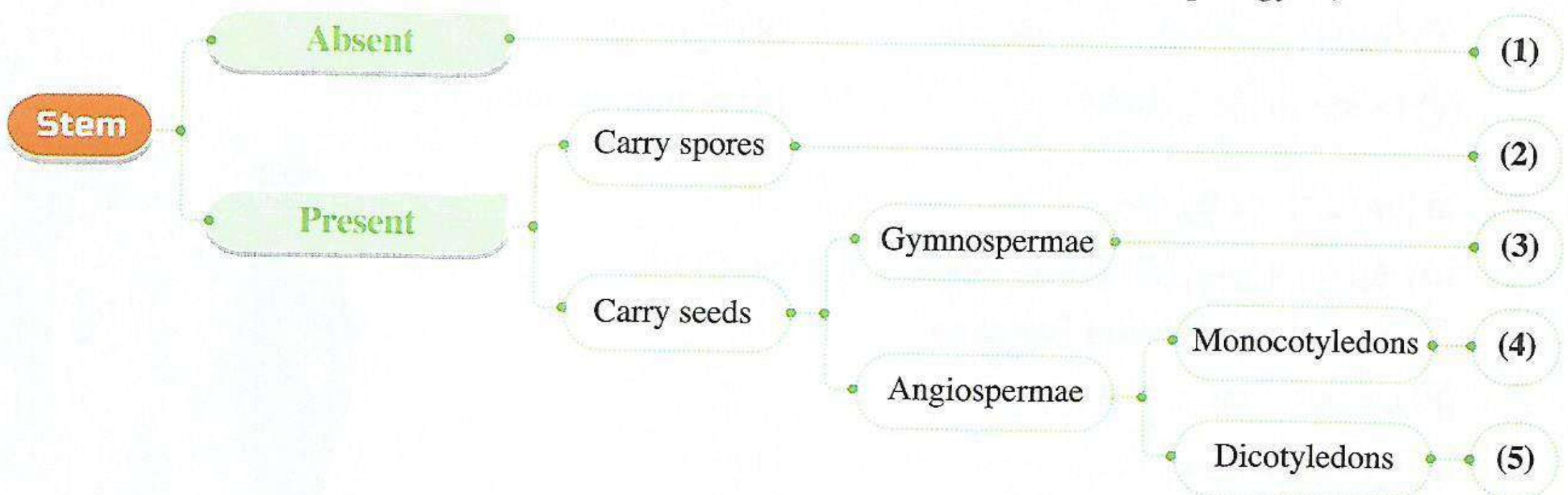
- 1 "All the unicellular organisms belong to the same taxonomic level".
How far this statement is correct ? With explanation.
- 2 Explain : algae have different colours.
- 3 In the light of your study to the traditional system of classification, suggest a kingdom to which *chlamydomonas* belong.
- 4 If you leave two pieces of bread, one of them is dry and the other is slightly wet with water in a warm place for 3 – 4 days, and when examining the putrefaction that was found on the wet piece of bread under microscope, the opposite organism was observed :
 - (a) What is the reason for the change that occurred to the wet piece of bread ?
 - (b) What is the source of the change that occurred to the wet piece of bread ?
 - (c) Why didn't this change occur to the dry piece of bread as in the case of wet piece of bread ?
 - (d) Mention the phylum to which the organism that is grown on the wet piece of bread belongs.
- 5 What happens if : *Riccia* is located in a dry environment ?
- 6 Explain : green plants are autotrophic, while fungi are heterotrophic.
- 7 Arrange the following organisms ascendingly, according to the degree of their taxonomic evolution : *Chlamydomonas* - *Nostoc* - Diatoms - *Penicillium* - *Polypodium*.
- 8 Explain : Pyrrophyta differs from Rhodophyta, despite being similar in colour and mode of nutrition.
- 9 Determine : the taxonomic standard upon which the bean plant is classified as dicotyledonous plant.
- 10 "*Polypodium* belongs to phylum Bryophyta". How far this statement is correct ?
With explanation.



- 11** Determine the method of reproduction in each figure of the following, with illustrating the figures that have xylem in their tissues :



- 12** ✎ Classify the following plants in their suitable places by using the following bilateral dichotomous key : (Pea - *Pinus* - *Polypodium* - Maize - *Spirogyra*)



- 13** ✎ Classify these organisms by making a dichotomous key for each of the following :

(a) (Bread mould fungus - Yeast fungus - *Penicillium* - Mushroom fungus), depending on :

- * Fungi structure (unicellular or multicellular).
- * The type of hyphae (divided or not divided).
- * The place of spores formation (inside the asci or inside the basidium).

(b) (*Polypodium* - *Pinus* - Cactus - Bean), depending on :

- * Flowering or non-flowering.
- * Forming seeds or not forming seeds.
- * The type of seeds (monocotyledons - dicotyledons).

- 14** "The organism may be unicellular, but more advanced than multicellular organisms".
How far this statement is correct ? With explanation.

Modern Classification of Living Organisms



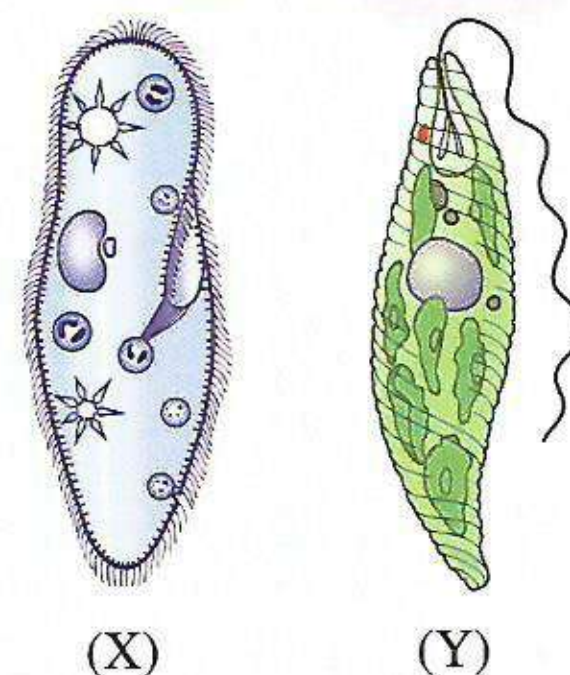
Choose the correct answer (1 : 10) :

- 1 The reason which proves that Eubacteria belongs to kingdom Monera is
- (a) the absence of plastids from their cells.
 - (b) the absence of pectin from their cell wall.
 - (c) that they are unicellular organisms.
 - (d) the presence of their genetic material in the cytoplasm.

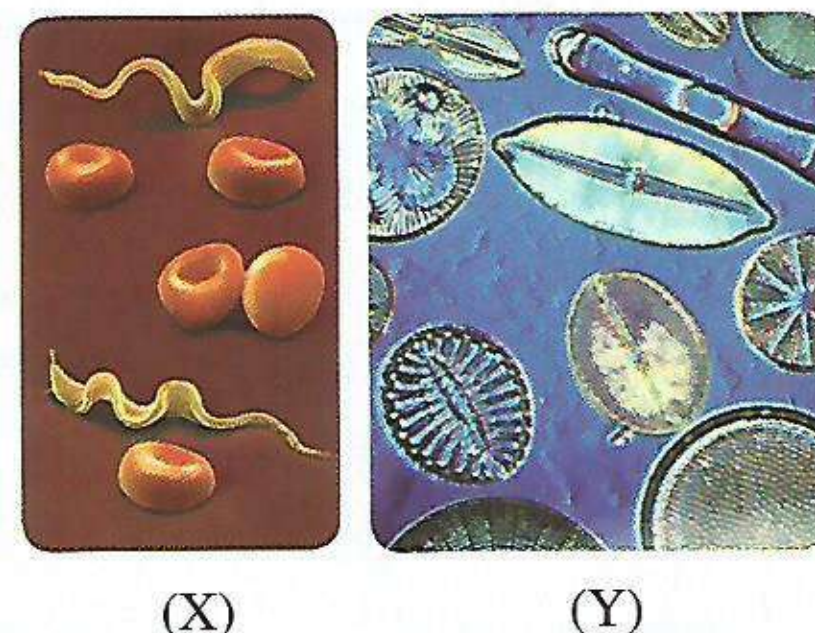
- 2 On examining a drop of fresh water from a pond, a unicellular living organism was found moving by cytoplasmic extensions. So, it is expected that this living organism belongs to
- (a) class Sarcodina.
 - (b) class Ciliophora.
 - (c) phylum Chrysophyta.
 - (d) phylum Pyrrophyta.

- 3 *Trypanosoma*, *Euglena* and most of Pyrrophyta are similar in
- (a) being autotrophic organisms.
 - (b) moving by flagella.
 - (c) living in fresh water.
 - (d) containing red pigment.

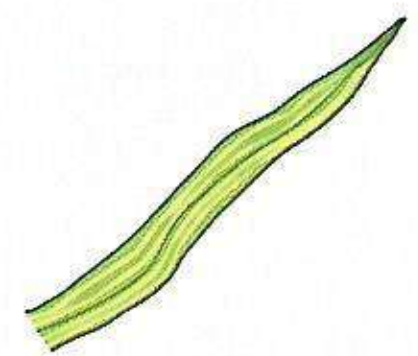
- 4 In the opposite figures :
Living organism (X) shares living organism (Y) in
- (a) being from phylum Protozoa.
 - (b) being autotrophic organisms.
 - (c) being eukaryotic.
 - (d) moving by cilia.



- 5 In the opposite figures :
Living organism (X) shares living organism (Y) in all of the following, except
- (a) the mean of locomotion.
 - (b) the number of cells.
 - (c) the type of nucleus.
 - (d) the kingdom to which they belong.



- 6 From the characteristics of fungi is that
- (a) they are autotrophic organisms. (b) they are from prokaryotes.
(c) they are mobile. (d) their cell walls consist of chitin.
-
- 7 Which of the following living organisms doesn't produce spores ?
- (a) *Penicillium*. (b) *Polysiphonia*.
(c) *Plasmodium*. (d) Mushroom fungus.
-
- 8 A living organism is characterized by being multicellular, immobile and having a cell wall composed of cellulose. This living organism belongs to kingdom
- (a) Monera. (b) Protista.
(c) Fungi. (d) Plantae.
-
- 9 All the following characteristics make the higher algae belong to kingdom Plantae, except that
- (a) they are characterized by the presence of cellulose cell walls.
(b) they contain vascular tissues.
(c) they are autotrophic.
(d) they contain chlorophyll in their cells.
-
- 10 From your examination to the opposite leaf, it may belong to
- (a) Ferns.
(b) Gymnospermae.
(c) Monocotyledons of Angiospermae.
(d) Dicotyledons of Angiospermae.



Answer of the following questions (11 : 17) :

- 11 The opposite figure illustrates a type of living organisms :
- (a) Determine the phylum to which it belongs.
- (b) Is the nutrition of this organism autotrophic or heterotrophic ?
And why ?



- 12 During your examination for two types of plants, you observed that one of them carries spores on the lower surface of its leaves and the other carries flowers.

Classify these plants, according to the modern classification of living organisms.

- 13 Explain : the cell walls of Diatoms differ from that of Chlorophyta in the type of substances entering into their composition.

- 14 The following living organisms (Yeast fungus - *Amoeba* - Bacteria - *Chlamydomonas*) are similar in being unicellular living organisms. They were supposed to be in the same kingdom, but they belong to different kingdoms.

Classify each living organism to its suitable kingdom, with explanation :

The living organism	Kingdom	Explanation
Yeast fungus		
<i>Amoeba</i>		
Bacteria		
<i>Chlamydomonas</i>		

- 15 ✓ "Not all the organisms that have green plastids belong to kingdom Plantae".

How far this statement is correct ? With explanation.

16 Compare between : *Funaria* plant and *Pinus* plant.

	<i>Funaria</i> plant	<i>Pinus</i> plant
The phylum :		
The vascular tissues :		

17 Algae have different colours, in the light of that, what is the colour that characterizes each alga in the following table ?

Alga	Its colour
<i>Polysiphonia</i>	
<i>Fucus</i>	
<i>Spirogyra</i>	
Dinoflagellate	



CHAPTER 3

LESSON ONE

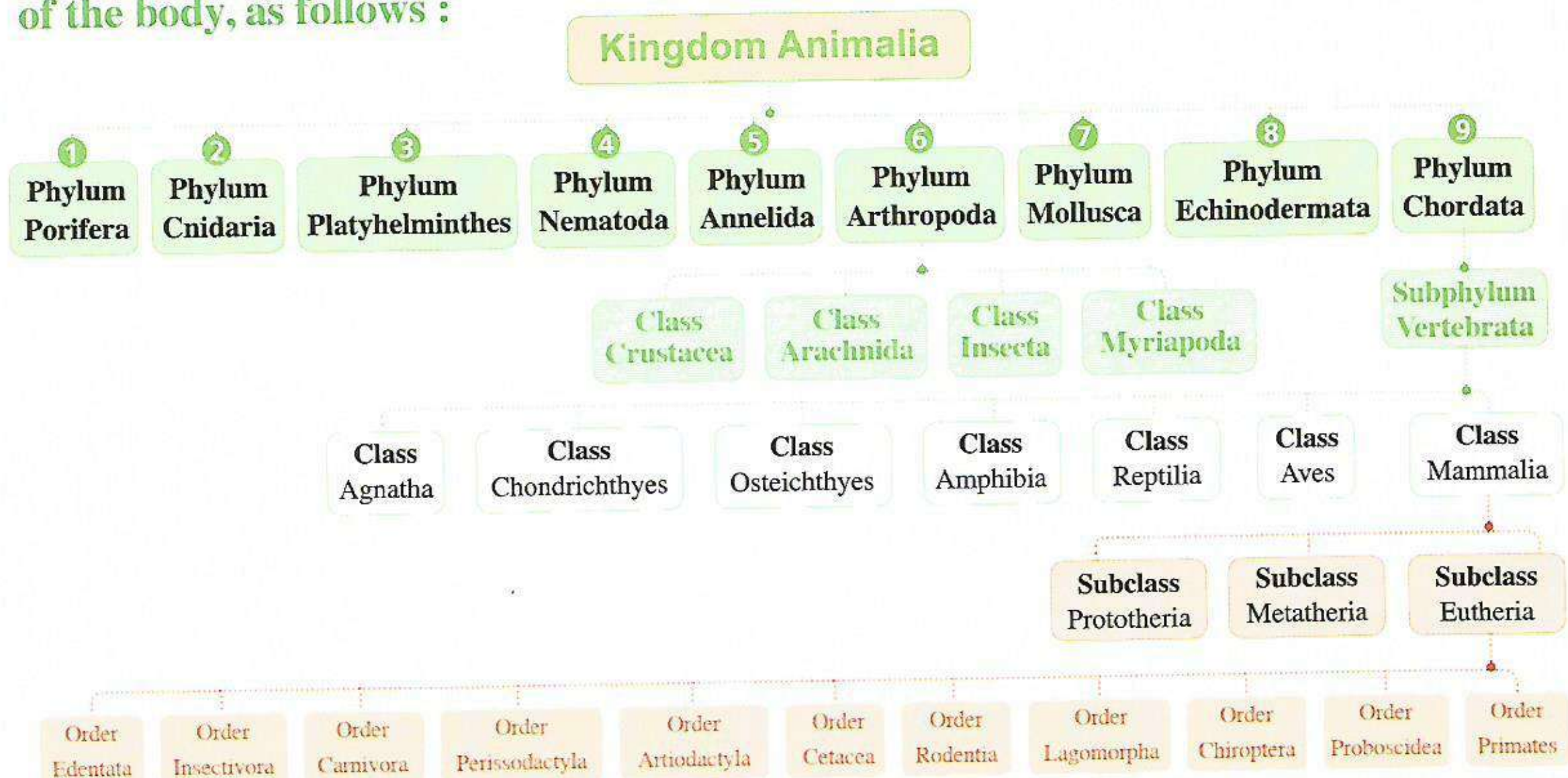
Kingdom Animalia

Fifth

Kingdom Animalia

General characteristics of kingdom Animalia

- **Structure** : all of them are multicellular.
- **Nucleus** : it is eukaryotic.
- **Locomotion** : they have the ability to move from one place to another.
- **Responding to stimuli** : they have the ability to respond rapidly to the external stimuli in the surrounding environment.
- **Reproduction** : most of them reproduce sexually.
- **The phyla of kingdom Animalia are divided into :**
 - ① **Invertebrates** : they don't contain a vertebral column.
 - ② **Vertebrates** : they contain a vertebral column inside their bodies.
- **Kingdom Animalia is classified into nine phyla, depending on the complexity degree of the body, as follows :**



1 Phylum Porifera (Sponges)

• Mode of living :

- Most of them live in seas and oceans and a few of them live in fresh water.
- They live individually (solitary) or in colonies.

• Locomotion : they are immobile, where they live attached to rocks.

• Body :

- It is simple-structured and asymmetric.
- Its shapes are varied, where it may be tubular or vase-shaped.
- It is hollow, its wall is supported by a skeleton of **spicules** or **fibers** or **both of them**, contains many pores and canals. Therefore, sponges are known as **poriferans**.
- Its cavity opens to outside by a large top opening called **osculum**.

• Sex : the majority are **hermaphrodite**.

• Reproduction : they reproduce sexually by **gametes** and asexually by **budding** and **regeneration**.

Example Sponge animal.

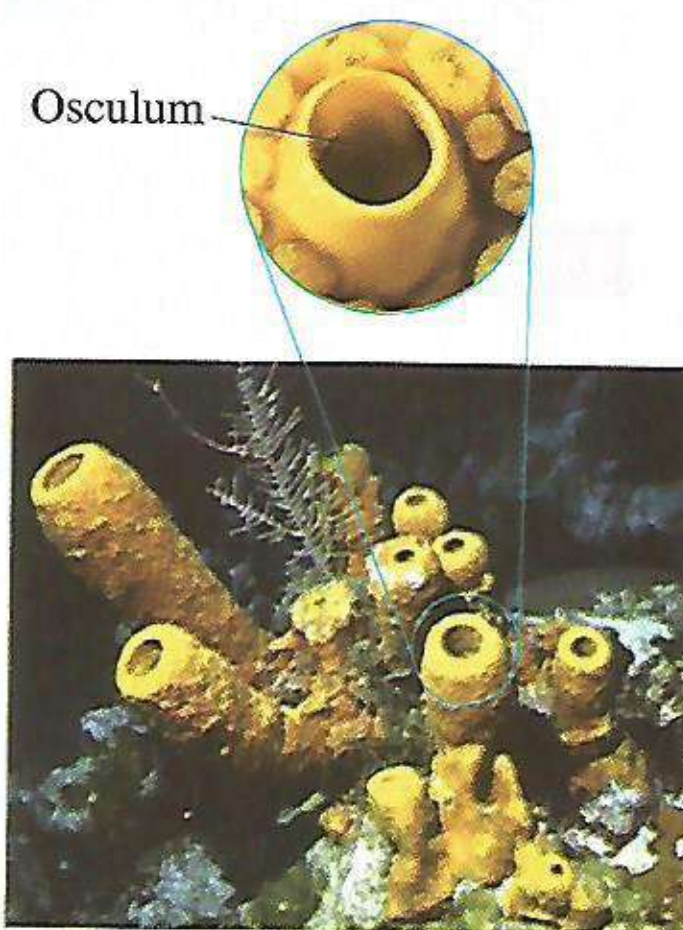


EKB

Note

Sponges are classified as animals, although they are immobile, because :

- They are multicellular.
- They are heterotrophic.
- They have no cell walls.
- They contain few specialized cells.



Sponge animal

1 Test yourself

Answered

Choose the correct answer :

Sponges and *Plasmodium* share each other in all the following, except

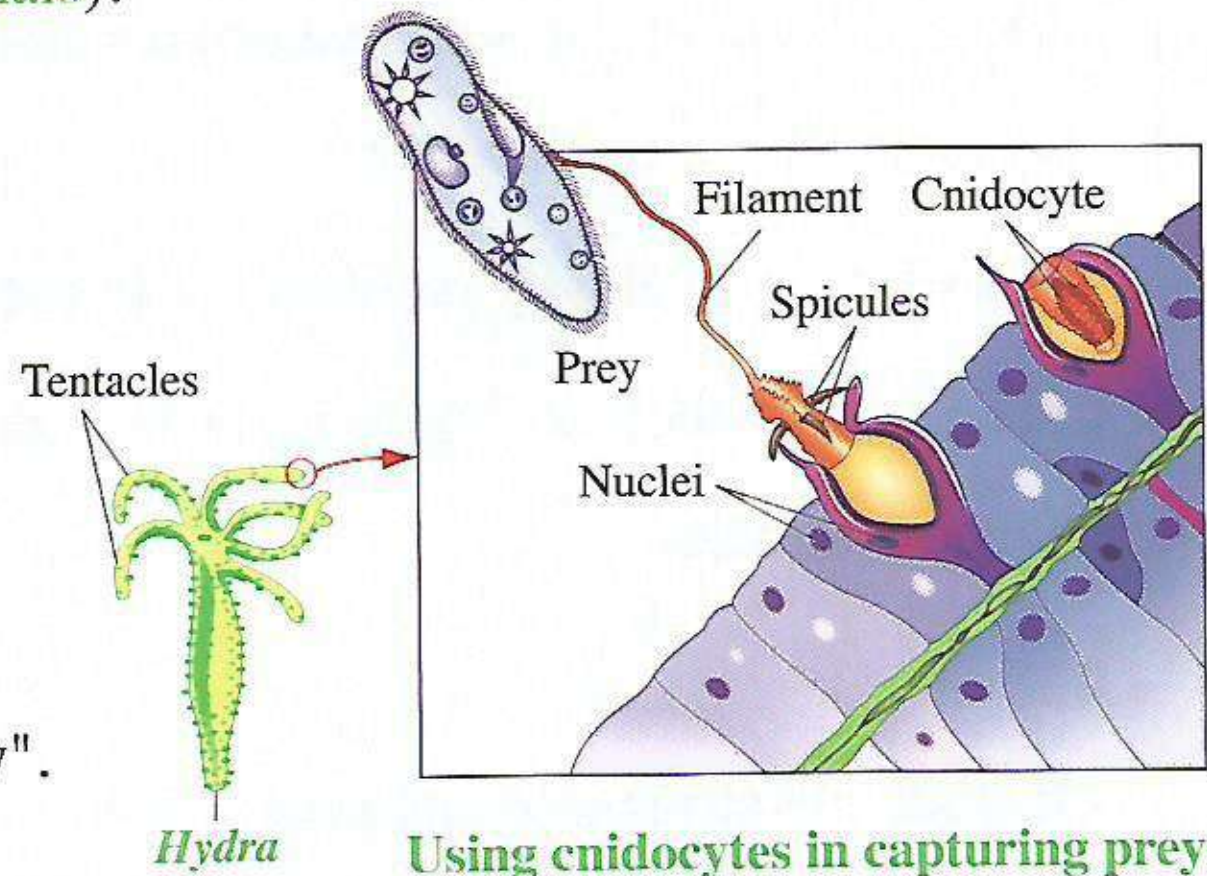
- the inability to move.
- being heterotrophic organisms.
- reproducing sexually and asexually.
- the complexity degree of the body.

2 Phylum Cnidaria

- **Mode of living :** the majority are marine, where they live individually or in colonies in water (i.e. they are aquatic animals).

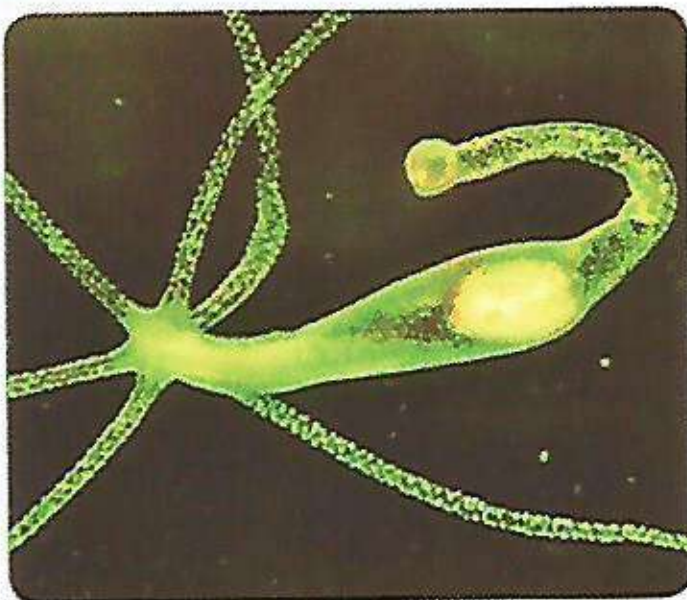
- **Body :**

- It doesn't have head.
- It has radial symmetry.
- It has a mouth that is surrounded by appendages and protrusions (extensions) called **tentacles**.
- It has a cavity called "gastrovascular cavity".
- It is provided with **stinging cells (cnidocytes)**.
- Its cells are arranged in two layers of tissues, where the outer one contains **cnidocytes** (stinging cells) which are found in plenty on the tentacles for self-defence and capturing preys.

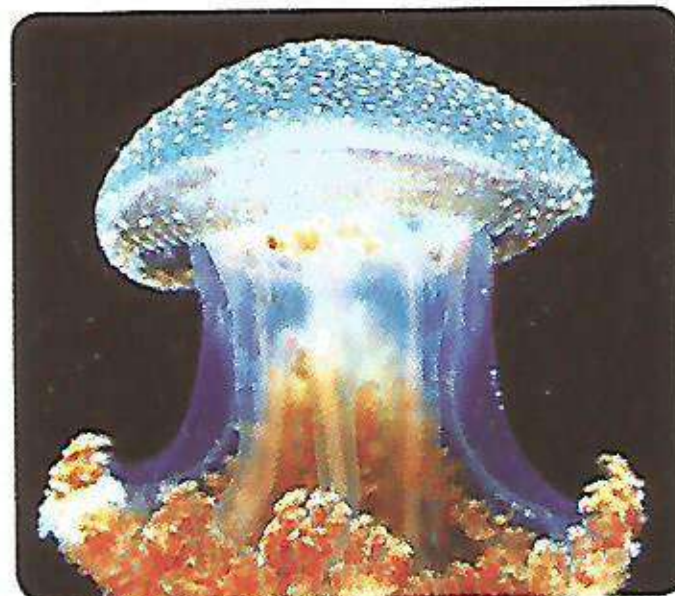


Using cnidocytes in capturing preys

Examples *Hydra* - *Aurelia* - Sea anemone.



Hydra



Aurelia



Sea anemone



2 Test yourself

Answered

Choose the correct answer :

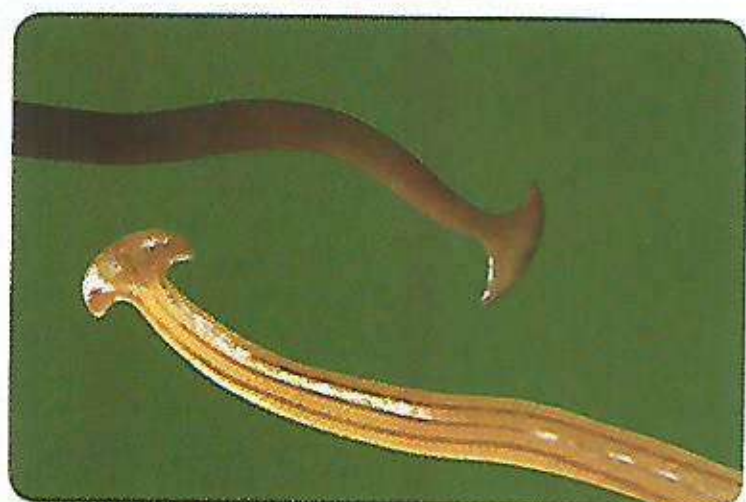
Although *Hydra* and bread mould fungus are heterotrophic, *Hydra* is characterized by getting its food through

- (a) parasitism. (b) predation. (c) saprophytism. (d) symbiosis.

3 Phylum Platyhelminthes (Flatworms)

- **Mode of living** : the majority are parasitic on two hosts and a few are free-living.
- **Body** :
 - It has a head.
 - It is flat. So, they are called **flatworms**.
 - It is composed of three layers (triploblastic) and is **bilaterally symmetric**.
- **Sex** : the majority are **hermaphrodite** and a few are **unisexual**.

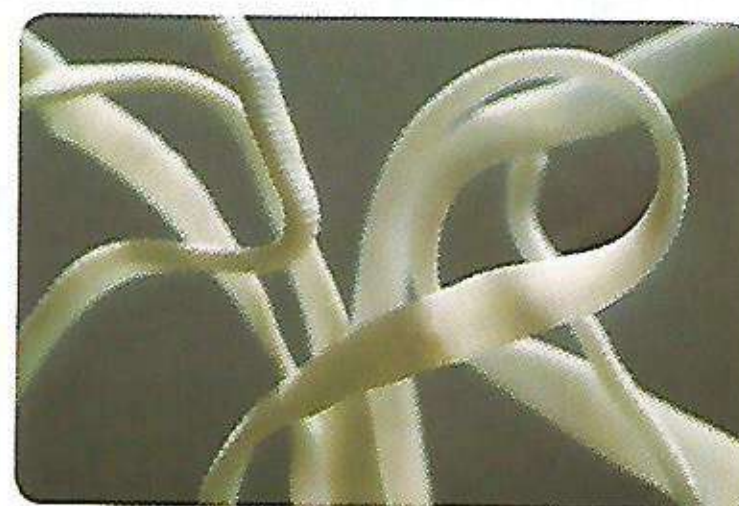
Examples *Planaria* worms - *Bilharzia* worms - Tapeworms.



Planaria worms



Bilharzia worms

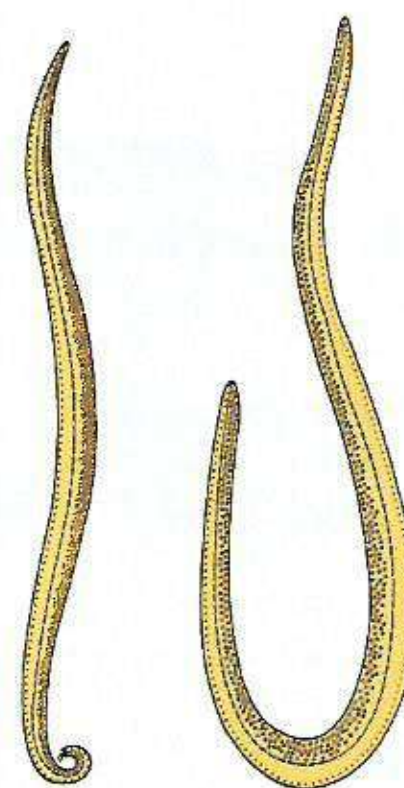


Tapeworms

4 Phylum Nematoda (Roundworms)

- **Mode of living** : they live in all environments, where some of them are free-living in water or mud, and the others parasitize the human, animals and plants.
- **Body** :
 - It is cylindrical, tapered at its two ends and unsegmented.
 - It consists of three layers and is **bilaterally symmetric**.
 - It has an alimentary canal with two openings which are mouth and anus.
 - Its size ranges from the microscopic to what may reach one meter in length.

- **Sex** : separated (**unisexual**).



Ascaris worm



Filaria worm

Examples - *Ascaris* worms.

- *Filaria* worms.

Enrichment information

- **Filaria** worms exist in the tropical regions of Asia continent. They parasitize the human blood and lymphatic vessels, causing elephantiasis disease, as the female Filaria lays a huge number of eggs and the micro-Filariae larvae hatch from it and transmitted to human by the biting insects, mainly mosquitoes.
- In cases of heavy infections, worms may become numerous and obstruct the flow of fluids through the lymphatic vessels, causing the swelling of the infected body parts. Therefore, this disease is called **Elephantiasis**.



Elephantiasis

5 Phylum Annelida (Ringworms or segmented worms)

- **Mode of living** : the majority are free-living in sea, fresh water or muddy soils and a few are external parasites.
- **Body** :
 - It is divided into rings (segments).
 - It has **chaetae** (spine-like structures) that are buried in the skin of most worms to help them in movement.
- **Sex** : some are **unisexual** and a few are **hermaphrodites**.



Earthworm

Examples

- **Earthworms** which live inside the soil in burrows, where they aerate the soil and increase its fertility.
- **Leech** which is external parasitic.



Leech

For illustration only

Medical importance of leech worms :

- Many medical substances are extracted from their saliva, such as :
 - Hirudin substance which is used in making anticoagulant drugs and in the treatment of the middle ear inflammation.
 - Vasodilator substance which is used to widen the blood vessels.
- It benefits in the blood distribution with high efficiency during the patching operation after the elimination of breast cancer tumors.



Practical Activity 5

Examining Earthworms to know the characteristic features of ringworms :

Used materials and tools :

- Earthworms in a container of damp soil.
- Old newspapers.
- Magnifying lens.
- Forceps.
- Plastic ruler.



Procedures	Observations
1 Place the worms over the old newspapers and describe its external shape, then measure its length by using the ruler.	1 Worms' body is divided into rings or segments and has a thin moist skin that contains chaetae (spine-like structures) on its ventral side. Its length reaches about 12 cm at rest.
2 Let the worms move and describe its movement.	2 It moves by contracting and relaxing its body segments.
3 Watch the body of the worms, when moving and explain how their external structures allow them to move.	3 When moving the worm adheres tightly to the surface where it placed on, by the help of the chaetae that are buried on its ventral side.
4 Try hearing the sound that is produced from the worms movement over the newspapers.	4 We hear a sound, due to the friction of chaetae with the surface of newspapers.
5 Catch a worm and pass your fingers on its ventral surface from back to front.	5 We feel roughness, due to the presence of chaetae under the skin.

Conclusion :

• The external features of Earthworms are :

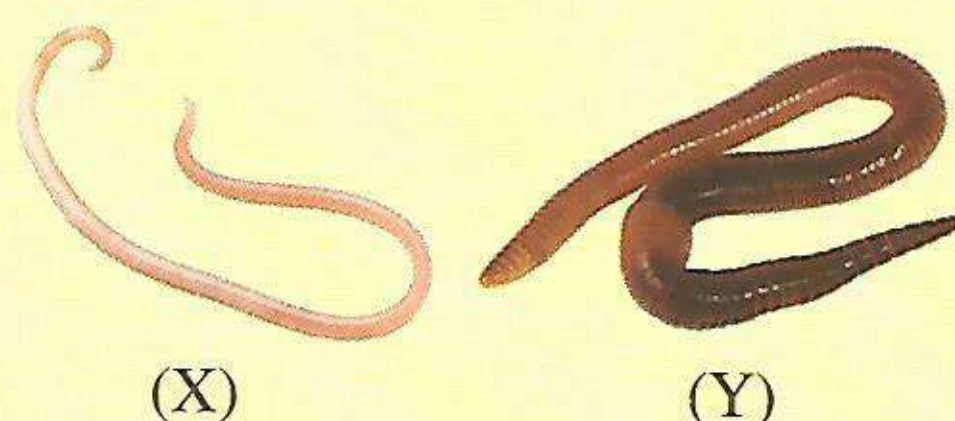
- Body is divided into rings (segments).
- Body has chaetae which are buried in the skin at the ventral side.

3 Test yourself

Choose the correct answer :

(1) Living organism (X) and living organism (Y) belong to the same

- (a) kingdom. (b) phylum.
(c) class. (d) order.



Answered

(2) Which of the following is applied to the opposite figure ?

- (a) Its body has head. (b) Its body is bilaterally symmetric.
(c) It lives freely. (d) It is a parasitic animal.



6 Phylum Arthropoda

• Body :

- It is **bilaterally symmetric**.
- It is divided into a number of segments which carry many pairs of appendages that are divided into several jointed pieces.
- It is divided into several regions that are covered by an **exoskeleton**.

• Phylum Arthropoda is classified into four classes, which are :

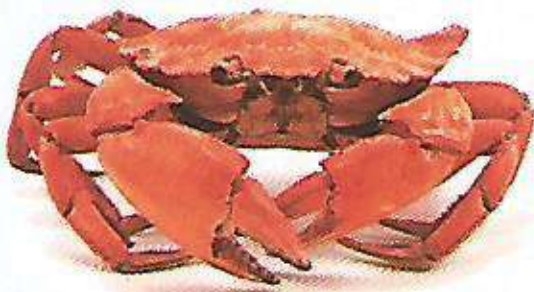
1 Class Crustacea	2 Class Arachnida	3 Class Insecta	4 Class Myriapoda
<ul style="list-style-type: none"> The body consists of two regions which are the cephalothorax and abdomen. It is covered with a chitinous cuticle. 	<ul style="list-style-type: none"> The body consists of two regions which are the cephalothorax and abdomen. 	<ul style="list-style-type: none"> The body consists of three regions which are the head, thorax and abdomen. 	<ul style="list-style-type: none"> The body consists of two regions which are the head and trunk that is composed of several segments.
<ul style="list-style-type: none"> They have many jointed appendages that are modified into different forms to perform various functions. 	<ul style="list-style-type: none"> They have four pairs of walking legs. They are unisexual (separated). 	<ul style="list-style-type: none"> They have three pairs of walking legs, some types have two pairs of wings such as (butterfly and dragonfly), while there are types have one pair of wings such as (houseflies and mosquitoes), and wingless types as (ants). 	<ul style="list-style-type: none"> They have many walking legs.
<ul style="list-style-type: none"> Their eyes are compound. 	<ul style="list-style-type: none"> Their eyes are simple. 	<ul style="list-style-type: none"> They have one pair of compound eyes and one pair of antennae. 	<hr/>
<ul style="list-style-type: none"> They breathe by gills. 	<ul style="list-style-type: none"> They breathe by tracheoles or lung books. 	<ul style="list-style-type: none"> They breathe by tracheoles. 	<ul style="list-style-type: none"> They breathe by tracheoles.

Examples

- Prawn.
- Crab (Sea cancer).
- Lobster.



Prawn



Crab

Examples

- Spiders.
- Scorpions.



Spider



Scorpion

Examples

- Flies. - Mosquitoes.
- Cockroaches.
- Ants. - Bees.
- Moths. - Locusts.
- Dragonfly.



Locust



Bee

Example

- *Scolopendra*.



Scolopendra



Enrichment information

Simple and compound eyes :

- **Simple eyes** : consist of one lens.
- **Compound eyes** : consist of a large number of separated lenses which work together to form a stereoscopic image of the object, where each lens picks up a different part of the object. The number, surface area and the shape of these lenses differ depending on the species.



Compound eyes

4 Test yourself

Answered

Choose the correct answer :

All the following features prove that this animal belongs to class Arachnida not Insecta, except

- (a) the segmented legs.
- (b) the method of respiration.
- (c) the body division.
- (d) the type of eyes.

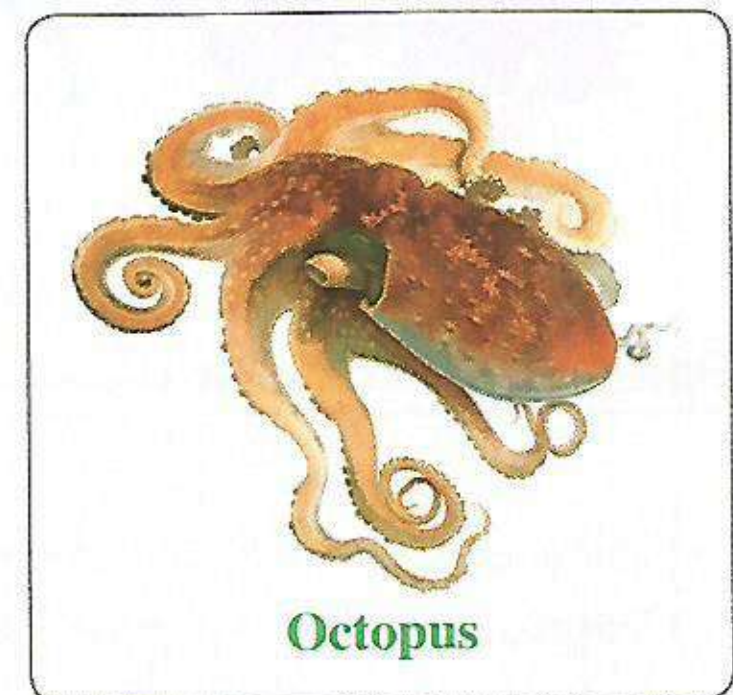
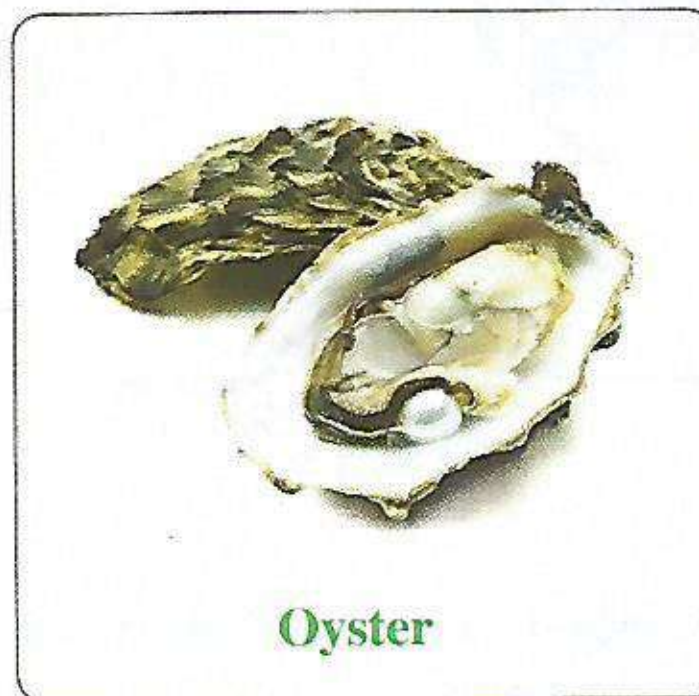
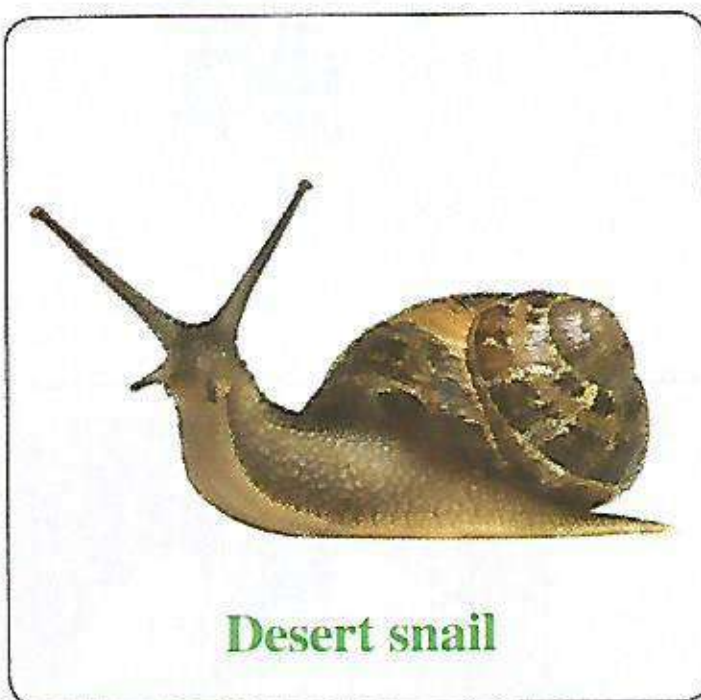


7 Phylum Mollusca



- **Mode of living** : the majority live in salt water, some in fresh water and a few on land.
- **Body** :
 - It is a soft mass.
 - It has a **calcareous shell** which may be external or internal, absent or reduced.
 - It is unsegmented and has a muscular part used in locomotion called **foot**.
 - It has a well-developed head (carries sense organs) and it may be absent in some species.
 - It has an organ that is similar to the tongue (in most molluscs), carrying rows of teeth which is called **radula** that is used in feeding.
- **Sex** : the majority are **unisexual** and a few are **hermaphrodites**.

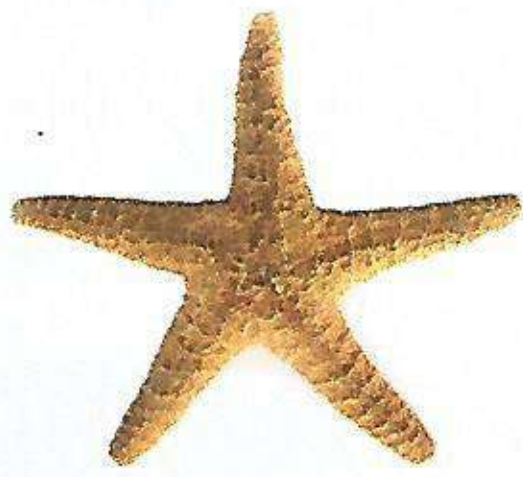
Examples Desert snail - Oyster - Octopus.



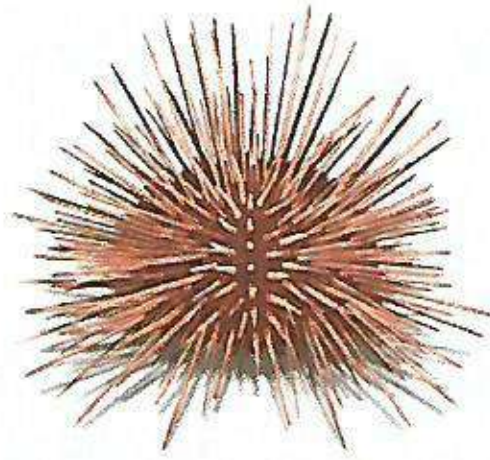
8 Phylum Echinodermata

- **Body** :
 - It may be rounded or cylindrical or star-shaped and some of them may have arms.
 - It is unsegmented and has a **hard endoskeleton**.
 - Its wall has **spines** and **calcareous plates** (in some of them).
 - It has sucker-like structures called **tube-feet**.
- **Locomotion** : they move by tube-feet or spines or arms.
- **The ends** : they have no anterior or posterior ends, where the majority have two surfaces (sides) :
 - The surface (side) where the mouth is located, is called the **oral surface**.
 - The opposite surface (side) is called the **aboral surface**.
- **Sex** : unisexual.
- **Reproduction** : they reproduce sexually by **gametes** and asexually by **regeneration**.

Examples Sea star - Sea urchin - Sea cucumber.



Sea star



Sea urchin



Sea cucumber



5 Test yourself

Choose the correct answer :

From the common features between living organism (X) and living organism (Y) is the

- (a) segmented and movable body.
- (b) presence of hard exoskeleton.
- (c) presence of head.
- (d) unsegmented and movable body.



(X)



(Y)

Answered

Kingdom Animalia



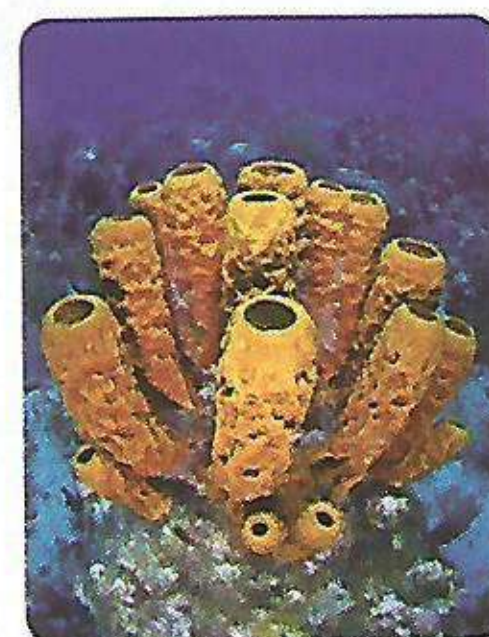
Interactive test

The questions signed by  measure the high levels of thinking.

First

Multiple Choice Questions

- 1 From the opposite figure that shows one of the marine living organisms, all the following make it belongs to kingdom Animalia, except that



- (a) it is heterotrophic.
- (b) it doesn't have cell walls.
- (c) it is immobile.
- (d) its cells are varied.

- 2 All the following are from the organisms that cause diseases to human, except

[Choose two answers]

- (a) tapeworms.
- (b) *Plasmodium*.
- (c) leeches.
- (d) *Trypanosoma*.
- (e) Earthworms.

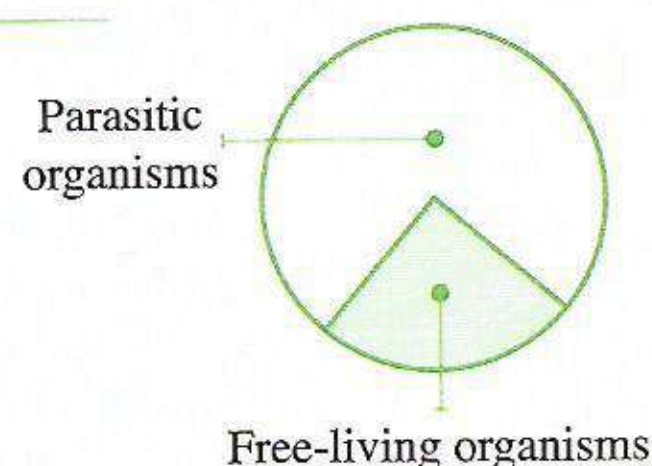
- 3 Which of the following are from the characteristics of the worms that some of them are free-living and the others are parasites ?

- (a) Their body is divided into pieces.
- (b) All of them are unisexual.
- (c) They have spine-like structures buried in the skin.
- (d) All of them are hermaphrodite.

- 4 Which of the following doesn't apply to Earthworms ?

- (a) They are parasites.
- (b) They are useful to human.
- (c) The skin is soft and moist.
- (d) They have segmented body.

- 5 The opposite figure illustrates the ratio of the free-living organisms to the parasitic organisms in one of the worms phyla, which of the following belongs to this phylum ?



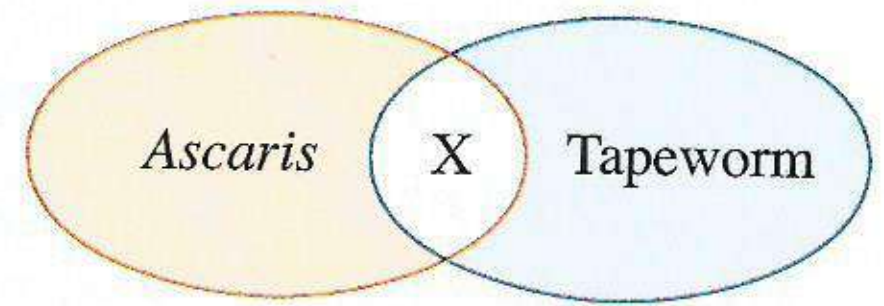
- (a) *Filaria*.
- (b) *Ascaris*.
- (c) Leech.
- (d) *Planaria*.

- 6 Which of the following characteristics is common between *Planaria* and leech worms ?

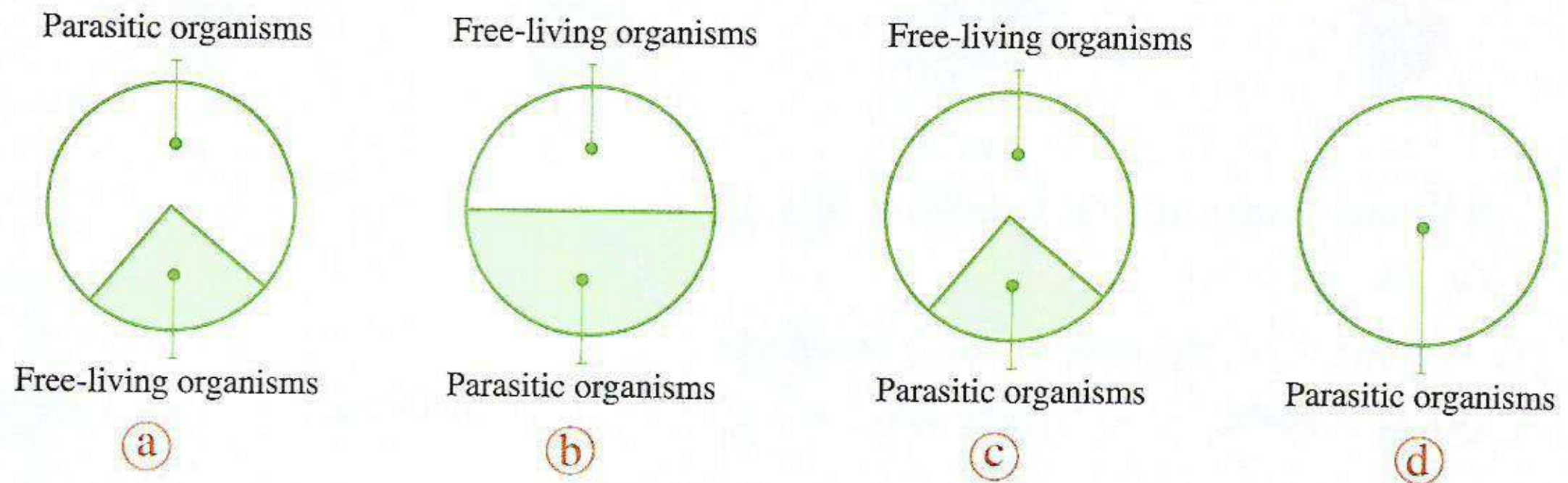
- (a) The body is divided into rings.
- (b) The body carries spines.
- (c) The mode of nutrition.
- (d) The taxonomic level.

7 By using the opposite figure, the letter (X) refers to

- (a) The body structure.
- (b) The symmetry of the body.
- (c) The presence of head in the body.
- (d) The sex.



8 On studying the body of one of the worms, spine-like structures buried in the skin were observed. Determine which of the following figures expresses the ratio of parasitic organisms to free-living organisms in the phylum that this worm belongs to



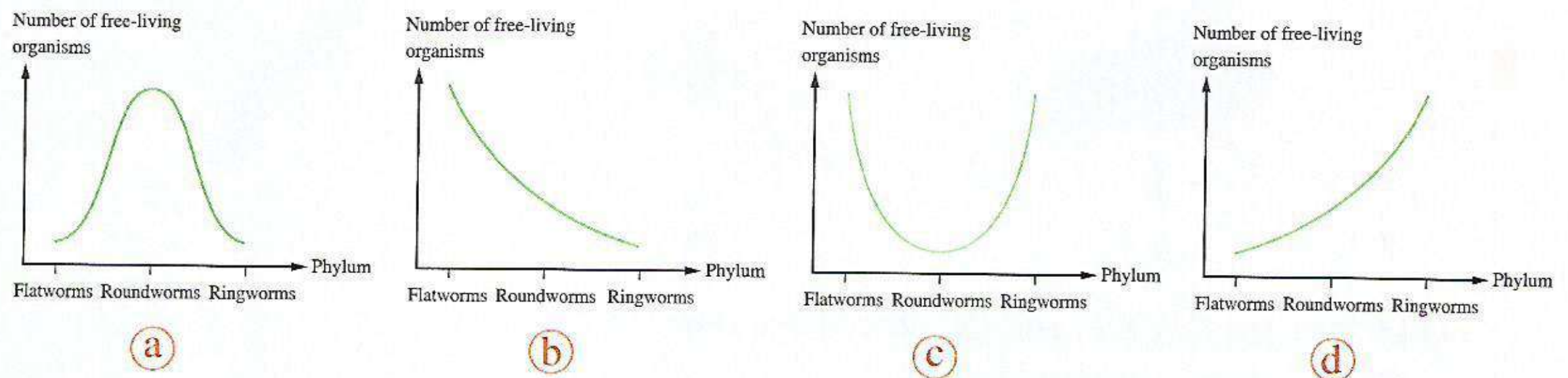
9 All the following are from the differences between organism (X) and organism (Y), except

[Choose two answers]

- (a) the body structure.
- (b) the phylum they both belong to.
- (c) the mode of living.
- (d) the body length.
- (e) the presence of true nucleus.



10 Which of the following graphs expresses the change in the number of free-living organisms according to the three phyla that are illustrated in the following graphs, using the modern classification ?



11 All the following worms are similar in their mode of living, except

- (a) hepatic worm (liver fluke).
- (b) Ascaris worm.
- (c) Bilharzia worm.
- (d) Earthworm.

12 As we move from phylum Platyhelminthes to phylum Nematoda till reaching phylum Annelida, we find that

- (a) parasitism increases and free-living character decreases.
- (b) free-living character increases and parasitism disappears.
- (c) free-living character increases and parasitism decreases.
- (d) parasitism increases and free-living character disappears.

13 Study the following organisms, then answer :



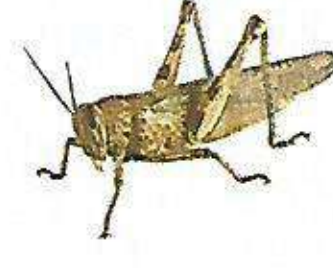
(X)



(Y)



(Z)



(L)

(1) The organism which is taxonomically different is

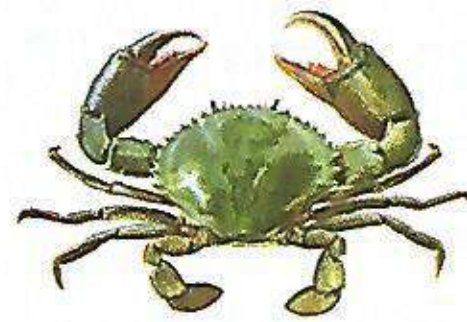
- (a) (X).
- (b) (Y).
- (c) (Z).
- (d) (L).

(2) The different organism belongs to class

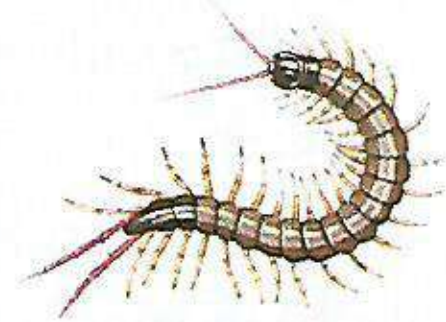
- (a) Arachnida.
- (b) Insecta.
- (c) Crustacea.
- (d) Myriapoda.

14 The opposite figures illustrate two invertebrates, what is the lowest taxonomic level in which they differ ?

- (a) Kingdom.
- (b) Phylum.
- (c) Class.
- (d) Subclass.



(1)



(2)

15 The standard upon which the differentiation between the classes of phylum Arthropoda depends on is

- (a) the appendages or segmented legs.
- (b) the method of respiration.
- (c) the body structure.
- (d) the type of eyes.

16 The following figures illustrate three invertebrates, study them, then answer :



(X)



(Y)



(Z)

(1) Organisms (X), (Y) and (Z) share each other in

- (a) the number of body regions.
- (b) the type of eyes.
- (c) reproducing asexually.
- (d) the presence of an exoskeleton.

(2) All the following are from the differences between organism (X) and organism (Y), except

- (a) the number of jointed appendages.
- (b) the type of eyes.
- (c) the number of body regions.
- (d) the division of the body into segments.

17 Study the following table, then answer :

Organism	Character	Kingdom
(A)	The mouth is located in the oral surface.	Animalia
(B)	It has an organ that is similar to the tongue carrying rows of teeth.	Animalia
(C)	It has a mouth that is surrounded by appendages and extensions.	Animalia

Which of the following organisms represent (A), (B) and (C) respectively ?

- (a) Sponge – Desert snail – Sea anemone.
- (b) Sea urchin – Oyster – Sponge.
- (c) Sea cucumber – Octopus – *Aurelia*.
- (d) Desert snail – *Aurelia* – Sea star.

18 Study the opposite figure, then answer the following :

(1) This organism belongs to

- (a) Crustacea.
- (b) Arachnida.
- (c) Insecta.
- (d) Mollusca.



(2) This organism can be distinguished between the classes of its phylum by having

- (a) a body that consists of two regions.
- (b) compound eyes.
- (c) an exoskeleton.
- (d) four pairs of walking legs.

19 We can differentiate between dragonfly and butterfly through the

- (a) type of eyes.
- (b) number of wings.
- (c) shape of wings.
- (d) presence of antennae.

20 The housefly differs from the mosquito in

- (a) carrying one pair of wings.
- (b) carrying compound eyes.
- (c) its legs are longer than its body.
- (d) its legs are shorter than its body.

21 Which of the following are from the similarities between *Scolopendra* and locust ?

[Choose two answers]

- (a) The number of body regions.
- (b) The number of legs.
- (c) The respiration method.
- (d) The simple eyes.
- (e) The phylum they both belong to.

22 From the opposite figure, study the morphological features of the shown organism, then answer the following :

(1) To which class does this living organism belong ?

- (a) Crustacea.
- (b) Insecta.
- (c) Arachnida.
- (d) Myriapoda.

(2) The class of this organism is determined according to

- (a) the presence of an exoskeleton.
- (b) the type of eyes.
- (c) the number of legs.
- (d) the method of respiration.



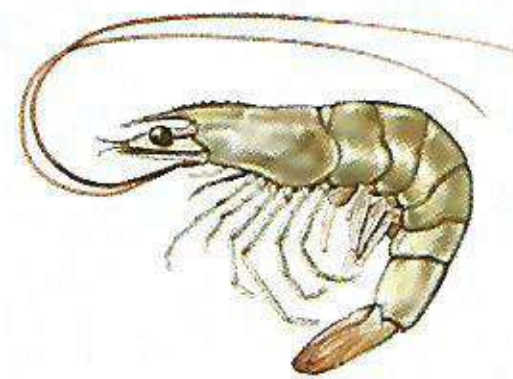
23 Study the two opposite figures, then answer :

(1) These organisms belong to different classes, because they differ in

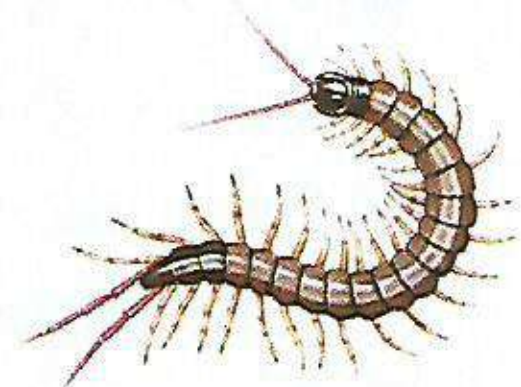
- (a) the number of body regions.
- (b) the type of legs.
- (c) the method of respiration.
- (d) the skeleton site.

(2) The two organisms share each other in

- (a) the segmented parts of the body.
- (b) the number of body regions.
- (c) the method of respiration.
- (d) the number of appendages carried by the body.



(1)



(2)

24 Which of the following statements is not applied to the desert snail ?

- (a) It has a soft mass body.
- (b) It has external calcareous shell.
- (c) It has an organ that is similar to the tongue carrying rows of teeth.
- (d) It moves by arms.

25 From the common features between the sea cucumber and the desert snail is

- (a) the site of the skeleton.
- (b) the number of the body arms.
- (c) the unsegmented body.
- (d) the foot shape.

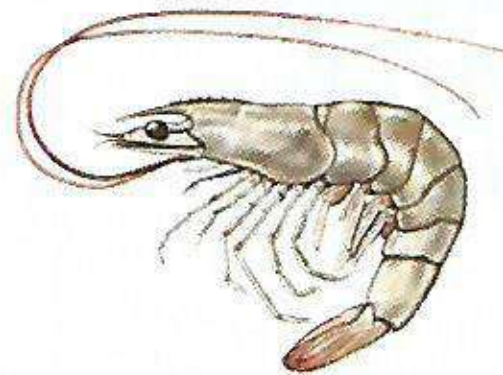
- 26 All molluscs and echinoderms are characterized by
- (a) having a head. (b) having a segmented bodies.
(c) having the ability to move. (d) being unisexual.
- 27 What is the taxonomic standard upon which the sea star is classified as phylum Echinodermata ?
- (a) The segmented body. (b) The exoskeleton.
(c) Moving by arms. (d) Being unisexual.
- 28 All the following are similarities between the sea urchin and the sea cucumber, except
- (a) the skeleton site. (b) the method of movement.
(c) the sex. (d) the reproduction type.
- 29 Which of the following considered from the higher invertebrates ?



(a)



(b)



(c)



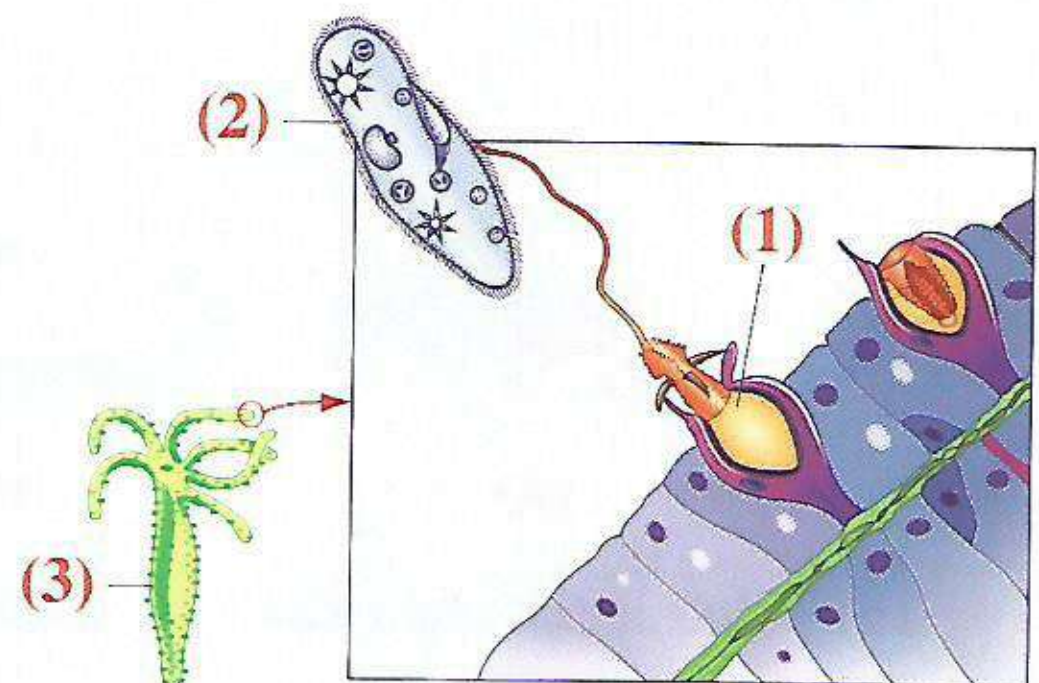
(d)

Second

Miscellaneous Questions

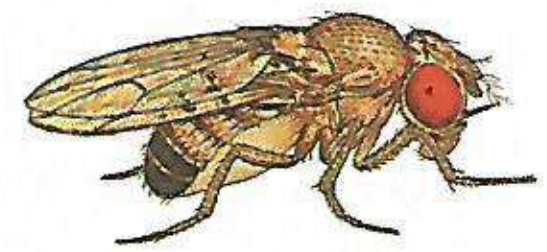
- 1 From the opposite figure :

- (a) Mention the function of structure no. (1).
- (b) To which phylum the organisms no. (2) and (3) belong ?



- 2 "Earthworm is from the useful worms". How far this statement is correct ? With explanation.
- 3 What happens in case of : the absence of chaetae that are buried in the skin of most ringworms ?
- 4 "The body of all arthropods is covered by calcareous shell". How far this statement is correct ? With explanation.
- 5 "The method of respiration in each of the crab and mosquitoes is similar". How far this statement is correct ? With explanation.

- 6 The opposite figure illustrates a male of *Drosophila* insect, write the name of the class to which *Drosophila* belongs, with illustrating the morphological features which make it belongs to this class.



- 7 "The presence of one pair of antennae is one of the main taxonomic standards in the classification of arthropods". How far this statement is correct ? With explanation.

- 8 What is the taxonomic standard upon which the crab is classified among arthropods ?

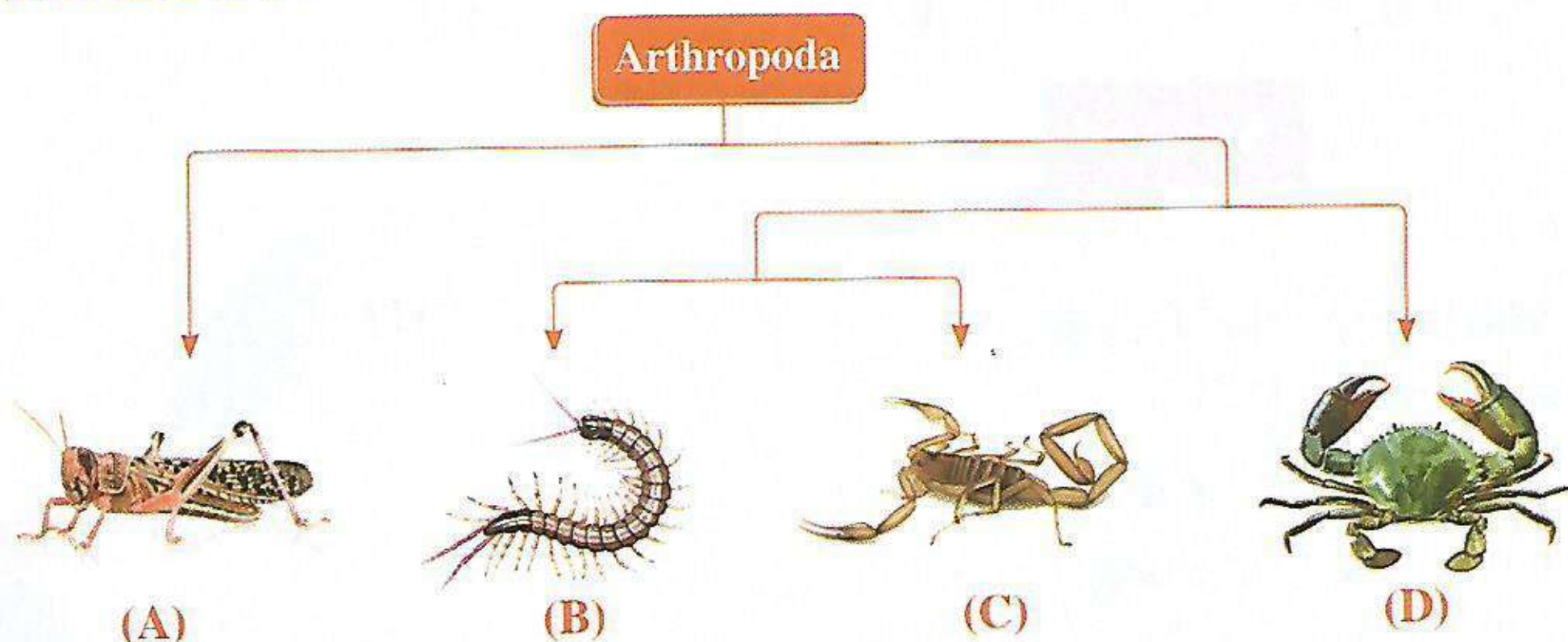
- 9 From the opposite table :

(a) Mention an example for organism (A) and organism (B).

(b) Compare between organisms (A) and (B), "according to : the body division and the movement organ".

	Organism (A)	Organism (B)
Body support	Calcareous	Chitinous
The body protection	External	External

- 10 The following diagram illustrates a dichotomous key for some arthropods (A), (B), (C) and (D) :

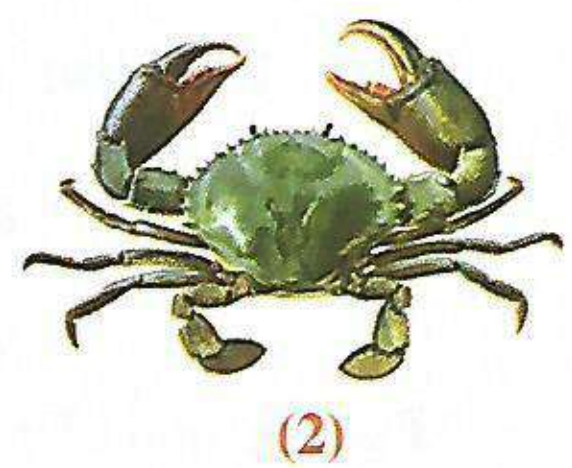


- (a) What is the character that animals (A) and (B) differ in ?
 (b) What is the character that animals (B) and (D) differ in ?
 (c) What is the character that animals (C) and (D) similar in ?

- 11 Study the opposite figures, then answer :

(a) Mention the similarities and differences between organisms no. (1) and (2).

(b) Mention the class to which organisms no. (1) and (2) belong.





CHAPTER 3

LESSON TWO

Continue : Kingdom Animalia (Phylum Chordata)

9 Phylum Chordata



EKB

- It includes the most higher animals in kingdom Animalia.
- The embryos of chordates are characterized by the presence of a skeletal structure at its dorsal region called **the notochord** which may either persist throughout the animal whole life or converted into a **vertebral column** in the majority of chordates.
- **Phylum Chordata** is classified into several subphyla, the most important one is subphylum **Vertebrata**.

Subphylum Vertebrata

- The notochord appears in vertebrates in the embryonic stage and is gradually replaced by the vertebral column which surrounds and protects the spinal cord as the embryo grows up.
- They have an **endoskeleton** which consists of the **vertebral column**, **skull**, **girdles** and **limbs**.
- They have circulatory system which consists of :
 - A heart that consists of several chambers.
 - Blood vessels in which blood flows in a **closed circulation** to supply all the body organs with oxygen and nutrients.

Note

• Vertebrates and thermal equilibrium :

- Warm-blooded animals :

They are animals that their body temperature doesn't change a lot with the change of the environment temperature, therefore they are called **endotherms** or **warm-blooded animals**. These animals use the food energy to keep their body temperature constant, such as birds and mammals.

- Cold-blooded animals :

They are animals that can't regulate their body temperature, where it changes according to the change of the surrounding environment, as they acquire their temperature from this environment. This group of animals are called **ectotherms** or **cold-blooded animals**, such as fishes, amphibians and reptiles.

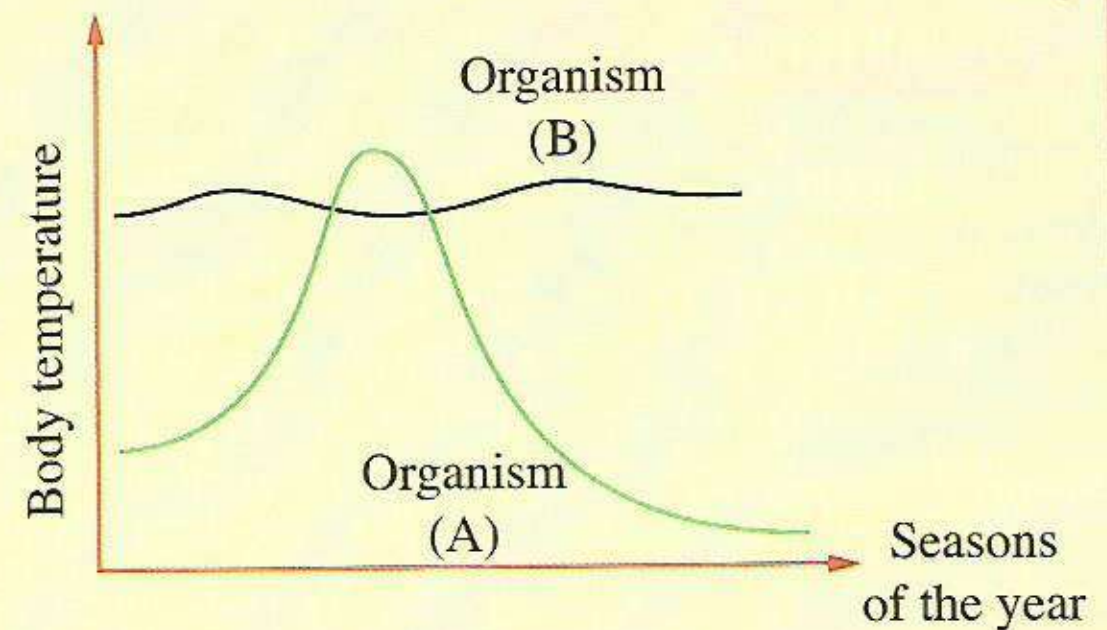
1 Test yourself

Answered

From the opposite graph :

Give an example for organism (A)
and an example for organism (B).

Explain your answer.



• Vertebrates are classified into several classes, including :

A Class Agnatha

- **Endoskeleton** : cartilaginous.
- **Body** : thin, long and eel-like with no paired fins.
- **Mouth** : circular, funnel-shaped, contains a rough tongue, provided with many horny teeth and jawless.
- **Feeding** : they are parasites, where they stick by their mouth to the big fishes and attach themselves by the **teeth**, then they snap the flesh of these fishes by their **rough tongue** which is similar to the rasp.



Lamprey

Example Lamprey

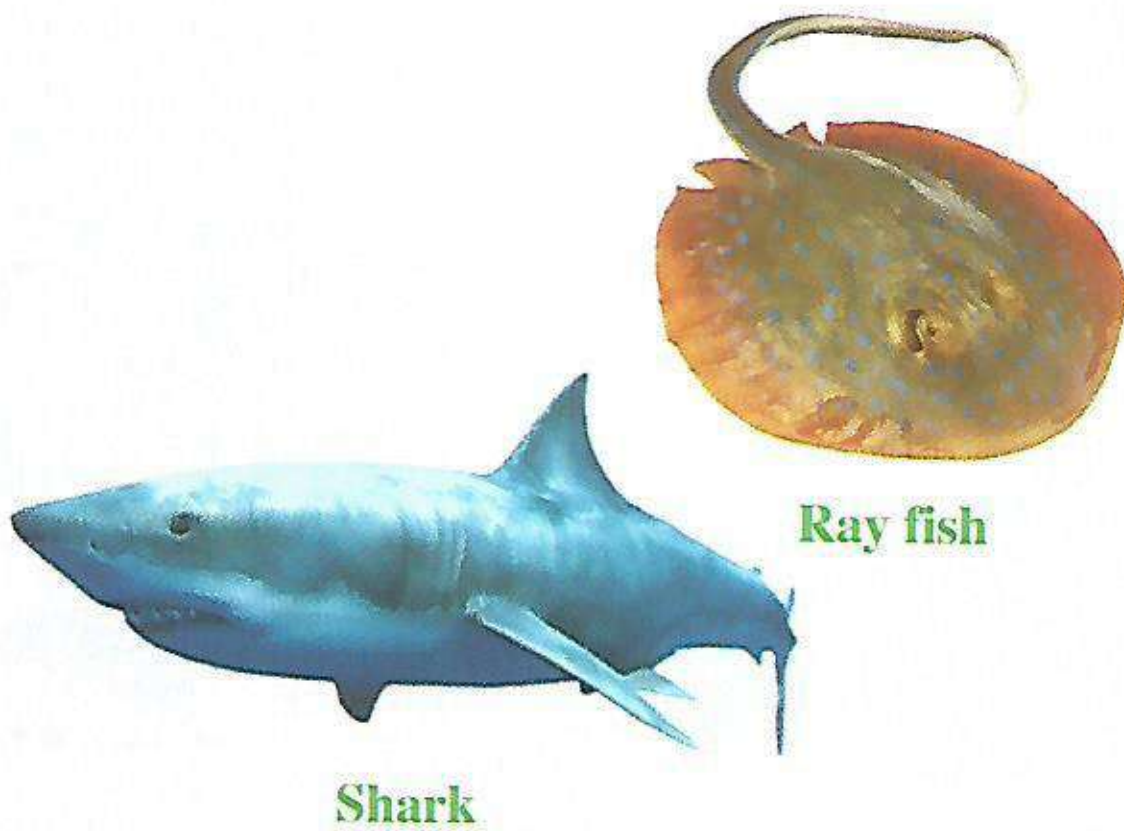
B Class Chondrichthyes

- **Habitat** : they live in salt water as seas.
- **Endoskeleton** : cartilaginous.
- **Body** : covered with scales that are similar to teeth.
- **Mouth** : ventral, i.e. it lies on the ventral surface of the head and provided by two jaws that carry several rows of teeth, helping them in predation.
- **Fins** : they are paired.
- **Gills slits** : they are not covered with an operculum.
- **Air bladder** : they have no air bladder.
- **Sex** : separated (unisexual).
- **Fertilization** : internal.

Examples

- Shark.

- Ray fish.



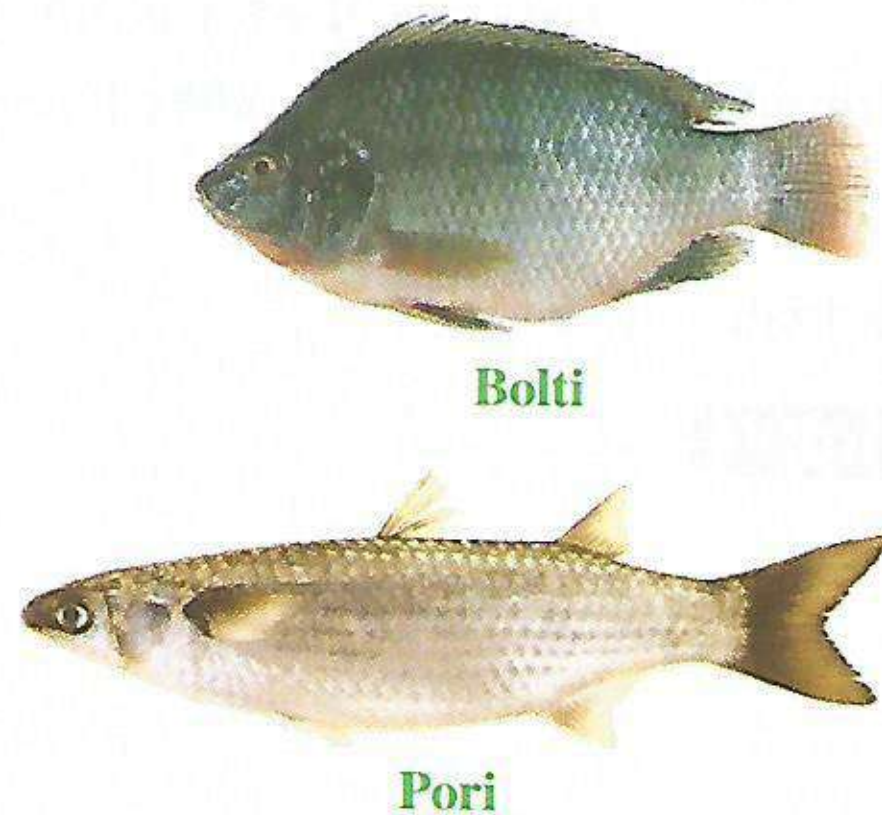
C Class Osteichthyes

- **Habitat** : they live in salt or fresh water.
- **Endoskeleton** : bony.
- **Body** : covered by bony scales.
- **Mouth** : terminal, i.e. it lies at the anterior tip of the body.
- **Fins** : they are medial and paired.
- **Gills slits** : they are covered with an operculum.
- **Air bladder** : they have an air bladder, helping them in swimming and floating.
- **Sex** : separated (unisexual).
- **Fertilization** : external.

Examples

- Bolti (Tilapia).

- Pori (Mullet).

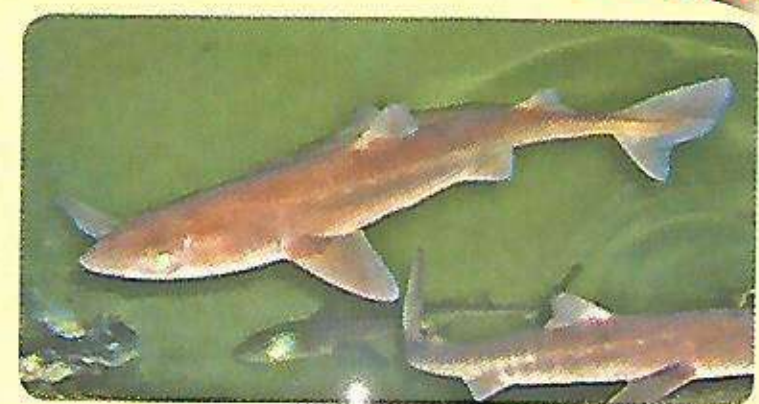


2 Test yourself

Choose the correct answer :

(1) Which of the following morphological features shown in the organism that is present in the opposite figure helps in identifying the class to which it belongs ? The presence of

- (a) mouth at the anterior tip of the body.
- (b) paired fins.
- (c) an operculum.
- (d) medial and paired fins.



Answered

(2) "The mouth of the cartilaginous fishes contains jaws that carry several rows of teeth". "Also they have a rough tongue like a rasp".

- (a) The first statement is correct and the second statement is wrong.
- (b) The first statement is wrong and the second statement is correct.
- (c) The two statements are correct.
- (d) The two statements are wrong.

D Class Amphibia

- They are **cold-blooded animals**.
- **Body** : covered by a smooth slimy skin.
- **Limbs** : they have **four pentadactyl limbs**.
- **Respiration** : it takes place by several different ways according to the stages of its growth, as follows :
 - **Embryonic stages** : they breathe by **gills**, because they live in water.
 - **Adult stages** : they breathe the atmospheric air by **lungs** and **skin**, because they live on land.
- **Sexes** are separated and **fertilization** is external.
- The females lay eggs in **water**.

Examples

- **Frog (toad).**
- **Salamander.**

Enrichment information

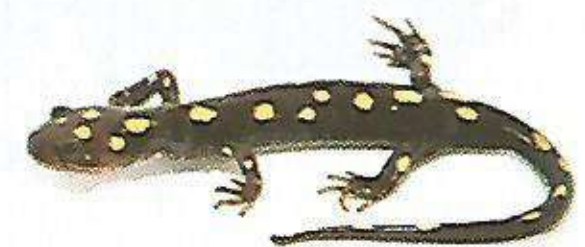
Frog croaking :

It is a sound that comes from the male frogs during the mating season for attracting the females for mating.

The male can produce this sound, because it has a special structure called "voice sac" which is not found in females.



Frog



Salamander

3 Test yourself

Answered

1 What are the similarities between : class Amphibia and classes of fishes ?

Class Amphibia	Classes of fishes
.....
.....
.....

2 Choose the correct answer :

All the following characterize the embryo of salamander, except that

- (a) the body is covered by a smooth skin.
- (b) it is from the warm-blooded animals.
- (c) it breathes by gills.
- (d) it lives in water.

E Class Reptilia

- They are **cold-blooded animals**.

- **Body :**

- It consists of four regions which are the **head, neck, trunk** and **tail**.
- It is covered by a dry skin with thick horny scales and it may be supported by horny plates.

- **Limbs :** they have **four weak pentadactyl limbs** and each toe ends with a horny claw.
The limbs may be absent. So, some of them move by **creeping**.

- **Respiration :** they breathe the atmospheric air by two **lungs**.

- **Sexes** are separated and **fertilization** is internal.

- The females lay eggs with calcareous or skiny shell.

Examples - **Crocodile.**

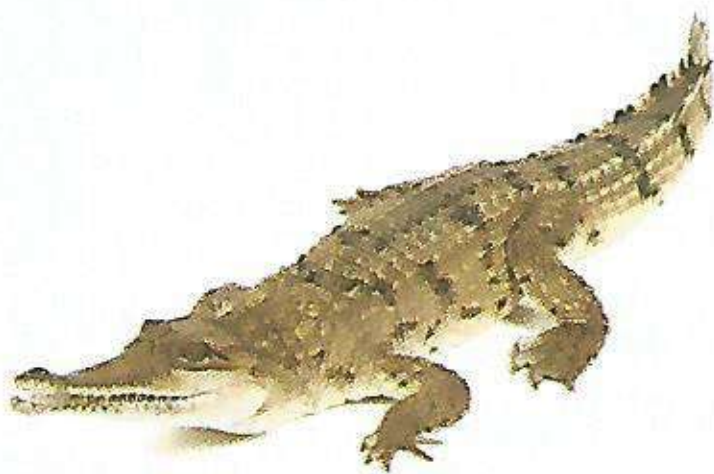
- **Tortoise.**

- **Gecko.**

- **Lizard.**

- **Chameleon.**

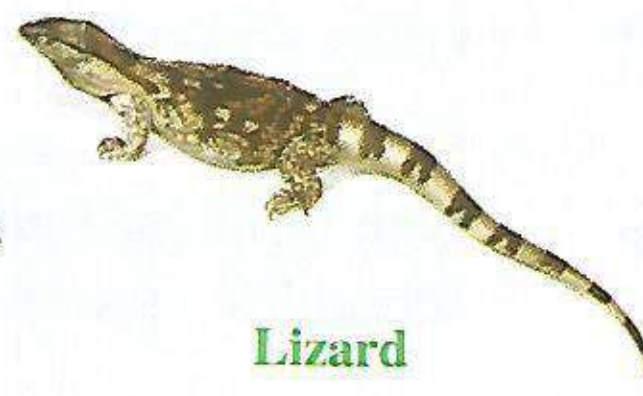
- **Snake.**



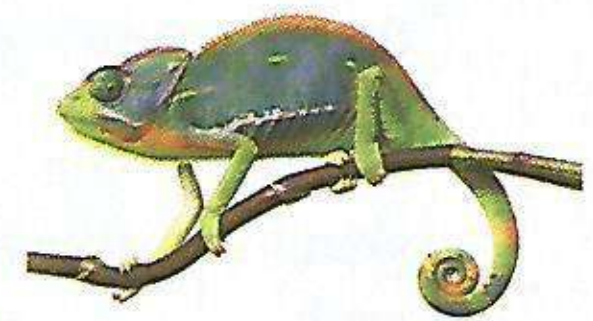
Crocodile



Tortoise



Lizard



Chameleon

4 Test yourself

Choose the correct answer :

In August 2007, a vertebrate with four limbs was discovered and it has no lungs, but it can breathe. To which class of vertebrates this animal belongs ?

- (a) Chondrichthyes.
- (b) Osteichthyes.
- (c) Amphibia.
- (d) Reptilia.

Answered



Practical Activity 6

Comparing between reptiles and amphibians :



Used materials :

- Preserved specimens of lizards and toads.



Toad

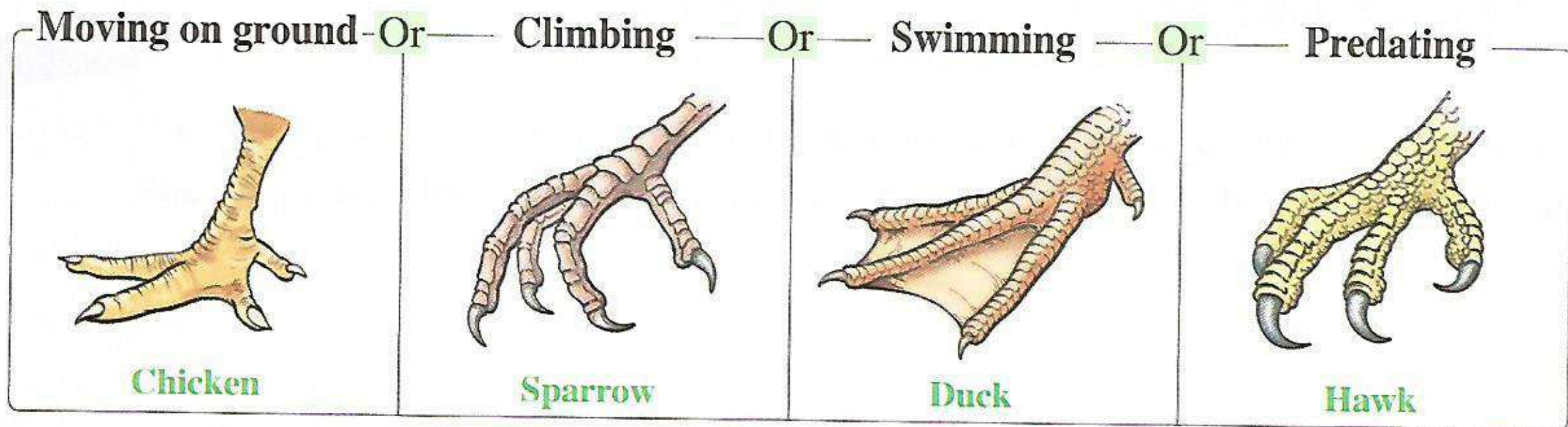


Lizard

Procedures	Toad	Lizard
<ul style="list-style-type: none"> Observe both the lizard and toad without touching, then : <ol style="list-style-type: none"> Describe the most important morphological structures for each one. 	<ul style="list-style-type: none"> Characteristics of the toad body : It consists of a head and trunk which contains two pairs of pentadactyl limbs. There is a smooth moist web (membrane) between the toes of the hind limbs that helps it to swim. The skin is smooth and moist with many different sized warts (granules) spread on it. 	<ul style="list-style-type: none"> Characteristics of the lizard body : It consists of a head, neck, trunk and tail. It has two pairs of short weak pentadactyl limbs. The toes end with claws, the skin is dry and covered with horny scales.
<ol style="list-style-type: none"> Determine the more obvious differences in the morphological structures and other differences that you observed. 	<ul style="list-style-type: none"> It has no tail. The hind limbs are more longer for jumping. 	<ul style="list-style-type: none"> It has tail. The limbs are equal in length.
<ol style="list-style-type: none"> Show how the skin looks like in each. 	<ul style="list-style-type: none"> Other differences : the texture and shape of the skin. Skin of toad is smooth, moist with different sized warts (granules) spread on it. 	<ul style="list-style-type: none"> Skin of lizard is dry and covered with horny scales.

F Class Aves

- They are warm-blooded animals.
- Body :** covered with feathers.
- Limbs :** they have four limbs, where :
 - The two anterior ones :** are modified into wings for flying.
 - The two posterior ones :** each one ends by four digits that are provided with horny claws which used for :



- **Respiration** : they breathe by **lungs**.
- **Sexes** are separated and **fertilization** is internal.
- The females lay eggs and incubate them till hatching.
- **Appropriateness (Adaptability) of internal structures of birds for flying** :
 - Their bones are hollow and light.
 - The sternum is broad for the attachment of the strong thoracic muscles which move the wings during flying.
 - Their bodies contain air sacs which are considered the storehouses for the additional amounts of air during flying.

Examples

- Sparrow.
- Pigeon.
- Hawk.
- Duck.
- Chicken.
- Ostrich.
- Eagle.



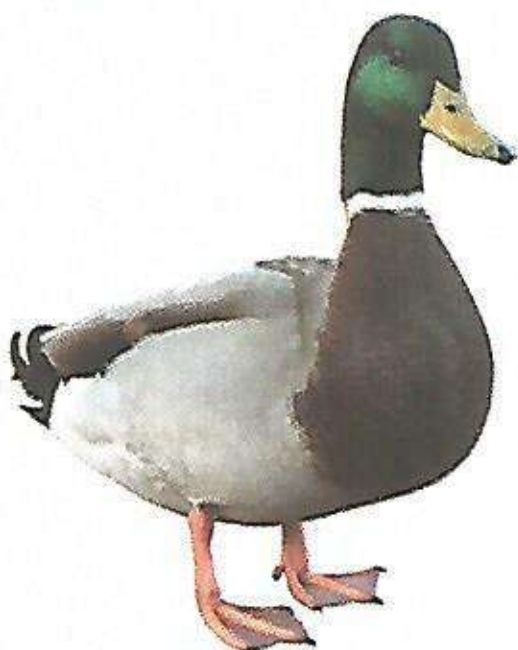
Sparrow



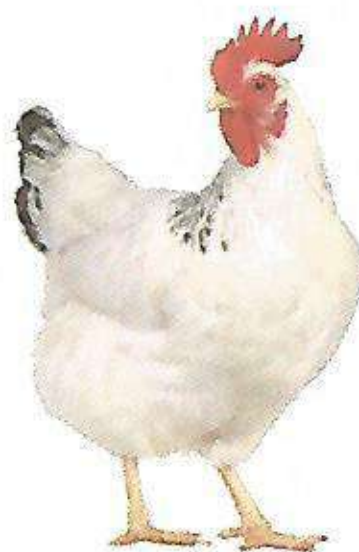
Pigeon



Hawk



Duck



Chicken



Ostrich

5 Test yourself

Answered

There are extra structures in the bodies of some vertebrates to store some gases, but they differ according to their function in the living organism. In the light of your study, determine to which classes the vertebrates containing these structures belong, and mention their function in each class.

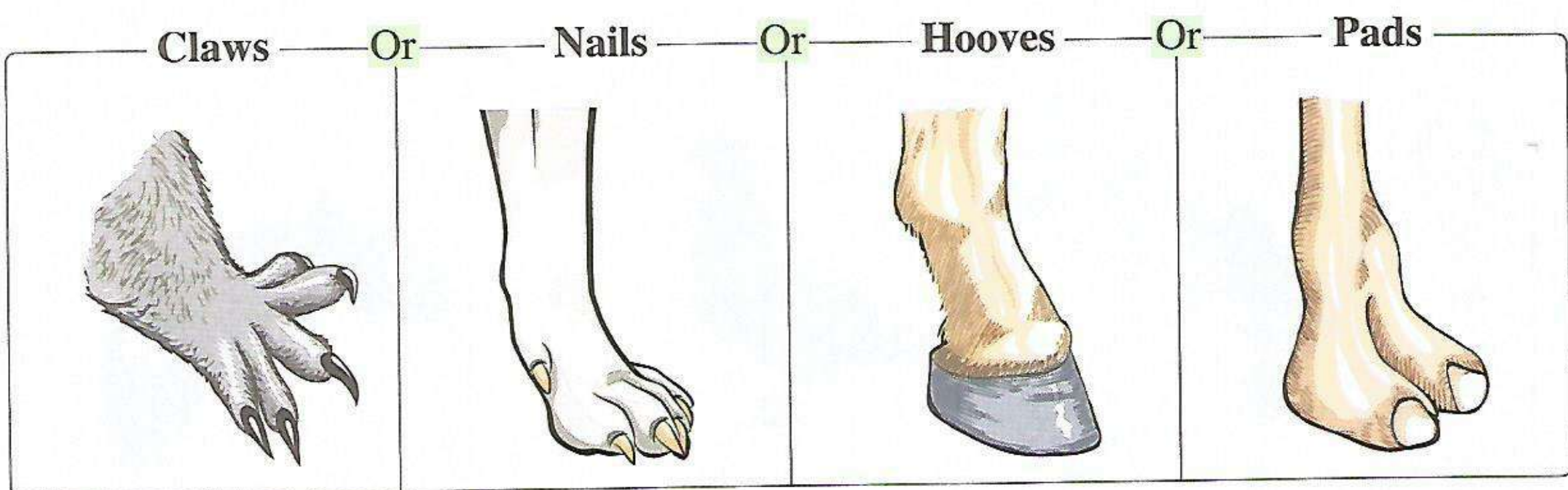
.....

.....

.....

G Class Mammalia

- They are warm-blooded animals.
- **Body :**
 - It consists of four regions which are the head, neck, thorax and abdomen.
 - It is surrounded by skin that is covered with hair.
- **Limbs :** they have four pentadactyl limbs that are provided with :



- **Respiration :** they breathe the atmospheric air by two lungs.
- **Teeth :** they are dissimilar (incisors, canines and molars).
- **Sexes :** separated.
- **Fertilization :** internal.
- The majority of females are viviparous and have mammary glands that secrete milk to suckle their young.

6 Test yourself

Answered

The opposite figure represents the squirrel animal :

(1) To which class does this organism belong ?

.....

(2) Which of the following characters help in determining the class of this animal ?

- (a) The endoskeleton.
- (b) Having four limbs.
- (c) The skin is covered by hair.
- (d) The presence of tail.

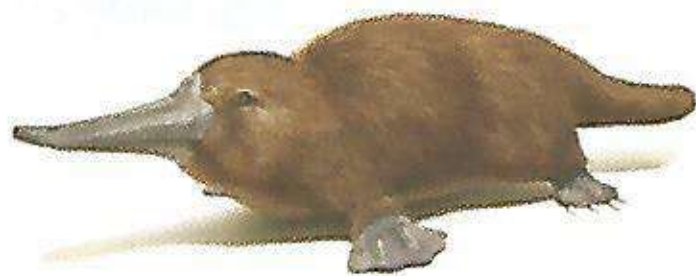


• Class Mammalia is classified into three subclasses which are :

1 Subclass Prototheria	2 Subclass Metatheria	3 Subclass Eutheria
<ul style="list-style-type: none"> • They don't give birth, but they lay eggs and incubate them. • The mother suckles its young with the milk that is secreted from the mammary glands on its abdomen. • They have a cloacal opening through which urine, faeces and eggs emerge. 	<ul style="list-style-type: none"> • They give birth to immature young. • The mother suckles its young from the nipples that are found inside a special pouch at the bottom of its abdomen where it keeps its young, until they become fully grown. 	<ul style="list-style-type: none"> • They are placental mammals that give birth to fully developed young. • The mother suckles its young with the milk that is secreted from its mammary glands.

Examples

- Duck-billed platypus.
- Spiny ant-eater.



Duck-billed platypus



Example

- Kangaroo.



Kangaroo

- Eutheria include many animals that are headed by the human, it is divided into many orders, the most important ones are :

- (1) Order Edentata.
- (2) Order Insectivora.
- (3) Order Carnivora.
- (4) Order Perissodactyla.
- (5) Order Artiodactyla.
- (6) Order Cetacea.
- (7) Order Rodentia.
- (8) Order Lagomorpha.
- (9) Order Chiroptera.
- (10) Order Proboscidea.
- (11) Order Primates.

7 Test yourself







Answered

Choose the correct answer :

Some babies may be born early before their time of birth which are called "premature babies". So, they need to stay in hospital for a period of time in the infant incubator. Which one of the following living organisms is similar to this case ?

- (a) Salamander.
- (b) Duck-billed platypus.
- (c) Lizard.
- (d) Kangaroo.

• Subclass Eutheria is classified into many orders, such as :

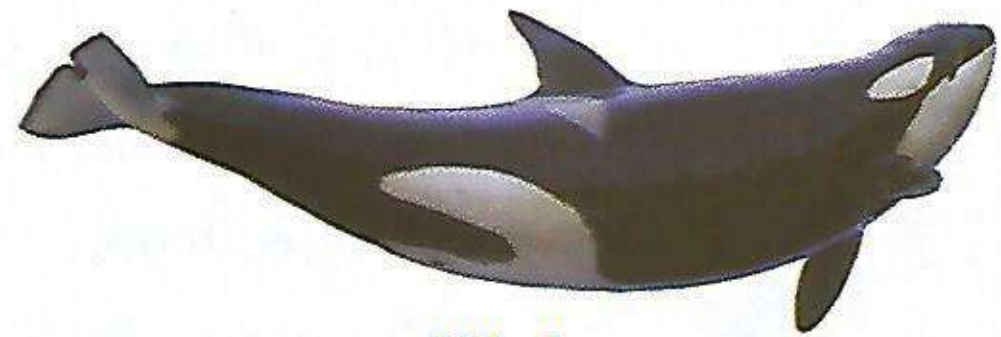
Order	Characteristics	Examples
<p>①</p> <p>Edentata :</p> 	<ul style="list-style-type: none"> • Some of them are toothless, while the others lost their front teeth only. • They have strong and curved claws. 	<ul style="list-style-type: none"> - Armadillo. - Sloth.  <p>Armadillo</p>
<p>②</p> <p>Insectivora :</p>	<ul style="list-style-type: none"> • They feed on insects. • Their front teeth are extended outward like pincers for capturing the prey. 	<ul style="list-style-type: none"> - Hedgehog.  <p>Hedgehog</p>
<p>③</p> <p>Carnivora :</p>	<ul style="list-style-type: none"> • They have large pointed canines. • The premolars are sharp, while the molars are broad for grinding. • They have strong, sharp and curved claws. 	<ul style="list-style-type: none"> - Lion. - Wolf. - Dog. - Seal. - Tiger. - Fox. - Cat.  <p>Dog</p>
<p>④</p> <p>Perissodactyla :</p>	<ul style="list-style-type: none"> • They are herbivorous animals. • They are odd-toed (1 or 3). • Each toe has a horny hoof. • Their teeth are big-sized and adapted to grind food. 	<ul style="list-style-type: none"> - Horse. - Donkey. - Zebra. - Rhinoceros.  <p>Horse</p>
<p>⑤</p> <p>Artiodactyla :</p>	<ul style="list-style-type: none"> • They are herbivorous animals. • They are even-toed. • Each toe is coated with a horny hoof. 	<ul style="list-style-type: none"> - Sheep. - Goat. - Giraffe. - Deer. - Camel.  <p>Giraffe</p>

6

Cetacea :

- They are huge aquatic animals that live in seas and oceans.
- Their two forelimbs are modified into paddle-like structures for swimming, while their hind limbs are disappeared.
- Tail fin is **horizontal**.
- They breathe the atmospheric air by two **lungs**.
- Sexes are separated.
- The females give birth and suckle their young.

- **Whale.**
- **Dolphin.**



Whale



Dolphin

7

Rodentia :

- They have a pair of incisors in both the upper and lower jaws.
- The incisors are sharp and chisel-shaped.
- The tail is long and ears are small.

- **Rat.**
- **Gerbo.**
- **Mouse.**
- **Squirrel.**



Mouse



Squirrel

8

Lagomorpha :

- They have two pairs of incisors in the upper jaw and one pair in the lower jaw.
- The tail is short and ears are long.

- **Rabbit.**



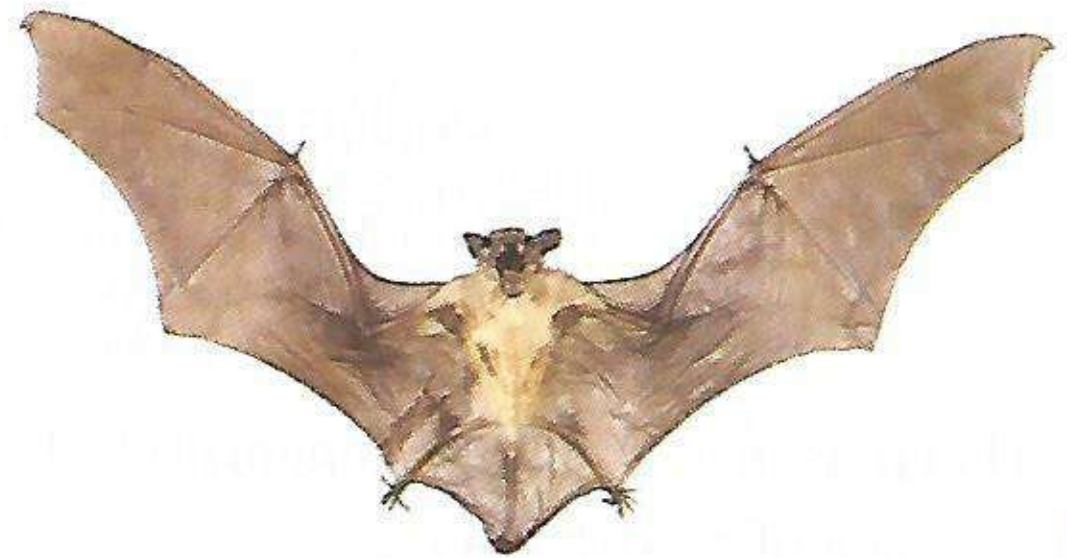
Rabbit

9

Chiroptera :

- Their forelimbs are modified into wings, where the fingers from the 2nd to the 5th are elongated and the skin extends from the body to in between these fingers.
- They are active during night.

- Bat.



Bat

10

Proboscidea :

- They have a long muscular proboscis.
- The two upper incisors grow to form what is known as the two **elephant canines**.

- Elephant.



Elephant

11

Primates :



- They are the most higher mammals.
- They have two pairs of pentadactyl limbs, and the thumb of the upper limbs lies away from the rest fingers.
- The brain is large-sized and the nervous system is highly developed in the higher forms.



Lemur

- Monkey.
- Lemur.
- Gorilla.
- Chimpanzee.
- Man.



Gorilla

8 Test yourself

Answered

From the following table :

Organism	Tail	Fur	Incisors
(X)	✓	✓	6
(Y)	✓	✓	4

(1) Give an example for organism (X) and organism (Y), then **mention** to which order each of them belongs.

.....

(2) How can you differentiate between organism (X) and organism (Y) according to other features ?

.....

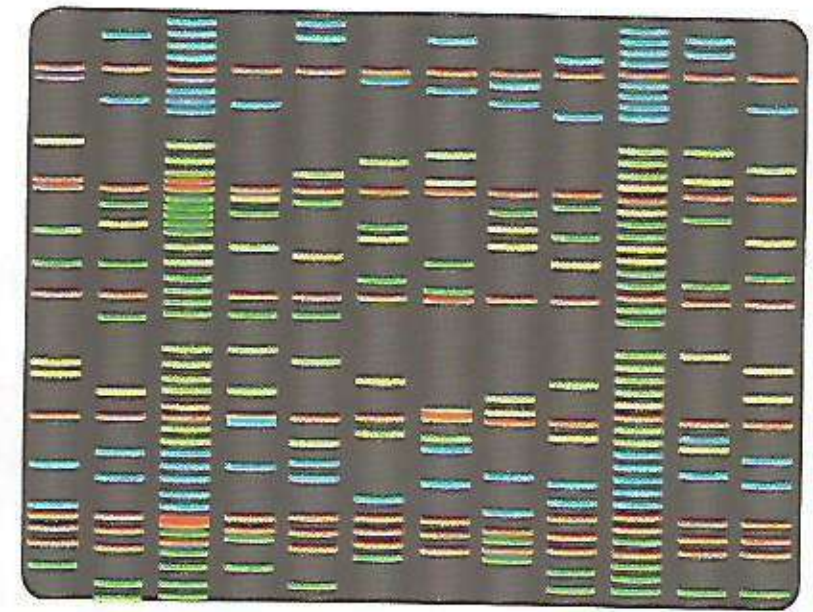
Science, Technology and Society

1 Modern technologies in classifying the living organisms

- For classifying the living organisms, the first scientists depended upon the **morphological comparisons** to determine the similarities and differences between the living organisms.
- Scientists turned to classify the living organisms (hundred years ago) on the basis of determining the degrees of relevance and relatedness (evolutionary relationships) among them **through** :
 - The researches in the field of comparative anatomy for determining the anatomical similarities.
 - The similarities in natural structures, such as :
 - Skeletal structures.
 - Glands.
 - The study of embryonic development.

- ③ Nowadays, through the development of microscopic screening techniques by the invention of **electron microscope** and the **development of biochemical analysis techniques**, new foundations for determining the degrees of relevance and relatedness among the living organisms appeared, **such as :**

The scientific researches on the nucleic acid DNA that exists in the nucleus through **DNA sequencing technique** in which the arrangement and sequence of nucleotides of DNA double helix are identified. Scientists found that the greater the similarity in the order of nucleotides in the DNA strand, the more relevant and related the organisms will be.



Sequences of DNA nucleotides

2 Frontiers in biology

- Recently, the researchers arrived to use the extract of sponges and cnidarians (especially jellyfish) in the biochemical and pharmaceutical industries, where :

- ① Some possible medical uses were investigated for the paralyzing toxins that some jellyfish use to capture the preys.
 - ② Investigating promising new antibiotics and anticancer compounds in some sponge species.
- Although this type of biotechnology is still recent, but it is very exciting, where these researches will probably result in the development of new medicines.



Jellyfish

Continue : Kingdom Animalia (Phylum Chordata)



Interactive test

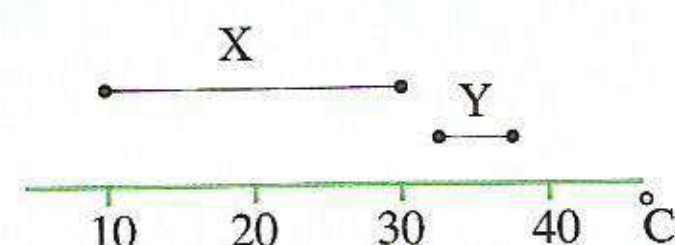
The questions signed by measure the high levels of thinking.

First

Multiple Choice Questions

- 1 All vertebrates are characterized by the presence of all the following, except the
- (a) skull.
 - (b) multi-chambered heart.
 - (c) closed blood circulation.
 - (d) opened blood circulation.

- 2 The following figure illustrates the thermal range of the body temperature for two different species of animals (X) and (Y), in the light of your study to the thermal equilibrium in vertebrates, you can conclude that



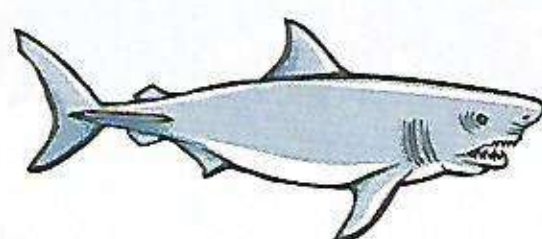
- (a) (X) is cold-blooded animal and (Y) is warm-blooded animal.
- (b) (X) is warm-blooded animal and (Y) is cold-blooded animal.
- (c) Both (X) and (Y) are cold-blooded animals.
- (d) Both (X) and (Y) are warm-blooded animals.

- 3 All the following living organisms have an internal support, except the

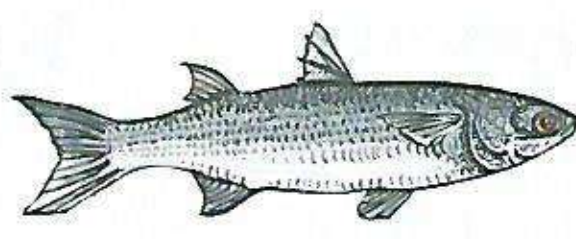
[Choose two answers]

- (a) lizard.
- (b) gecko.
- (c) scorpion.
- (d) salamander.
- (e) spider.

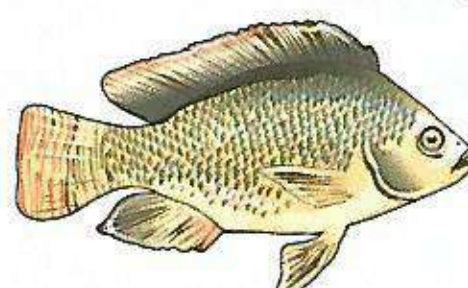
- 4 Which of the following fishes has a soft connective tissue forming its skeleton ?



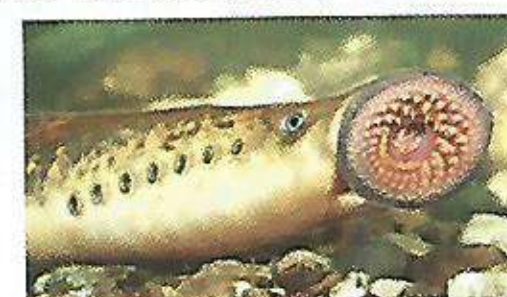
(1)



(2)



(3)



(4)

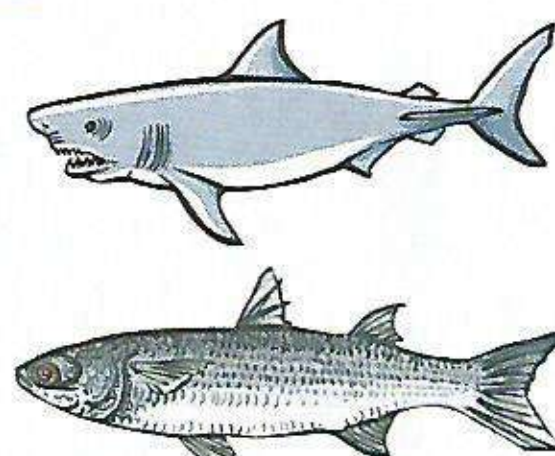
- (a) (1) and (2).
- (b) (1) and (4).
- (c) (2) and (3).
- (d) (2) and (4).

- 5 Ray fish is similar to *Lamprey* in all the following, except [Choose two answers]

- (a) the presence of teeth.
- (b) the presence of paired fins.
- (c) the type of blood.
- (d) the type of endoskeleton.
- (e) the presence of tongue.

- 6 The opposite two figures are different in

- (a) the type of endoskeleton.
- (b) the type of blood.
- (c) the presence of gills.
- (d) the presence of paired fins.



- 7 There are some living organisms live in the Red Sea with different sizes and have endoskeletons rich in calcium, which of the following classes include these organisms ?

(a) Chondrichthyes. (b) Osteichthyes. (c) Agnatha. (d) Crustacea.

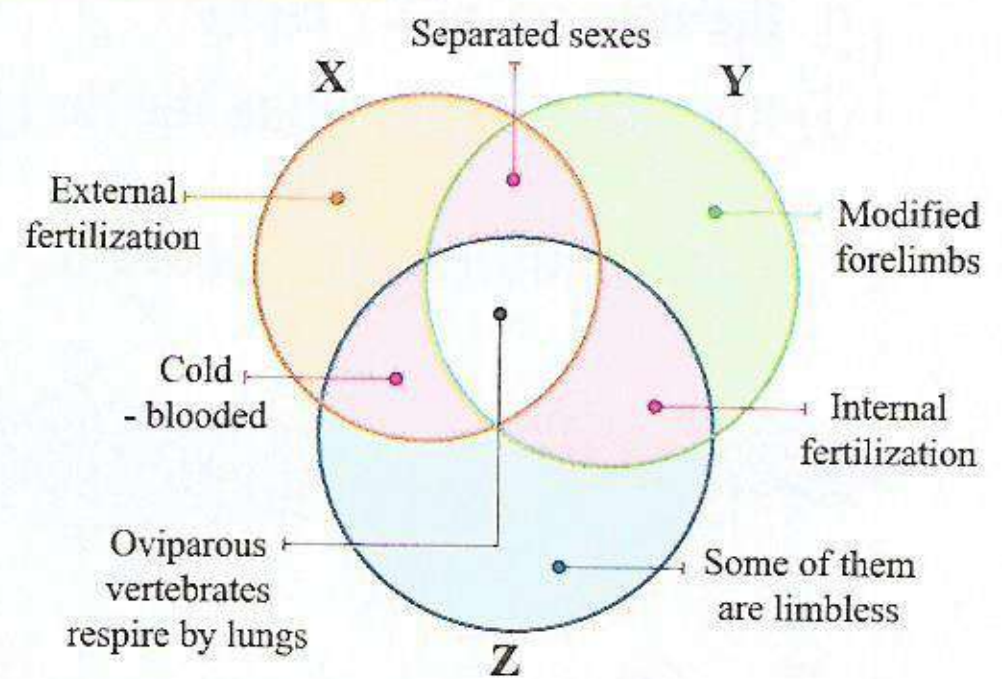
- 8 Bolti fish shares the embryonic stage of toad in the

(a) method of respiration. (b) presence of air bladder.
(c) presence of paired fins. (d) shape of skin.

- 9 From the opposite figure :

- (1) The is from the organisms that belong to group (X).

(a) adult stage of salamander
(b) embryonic stage of lizard
(c) bolti fish
(d) embryonic stage of frog



- (2) From the organisms that some of their individuals can move in two different media are the

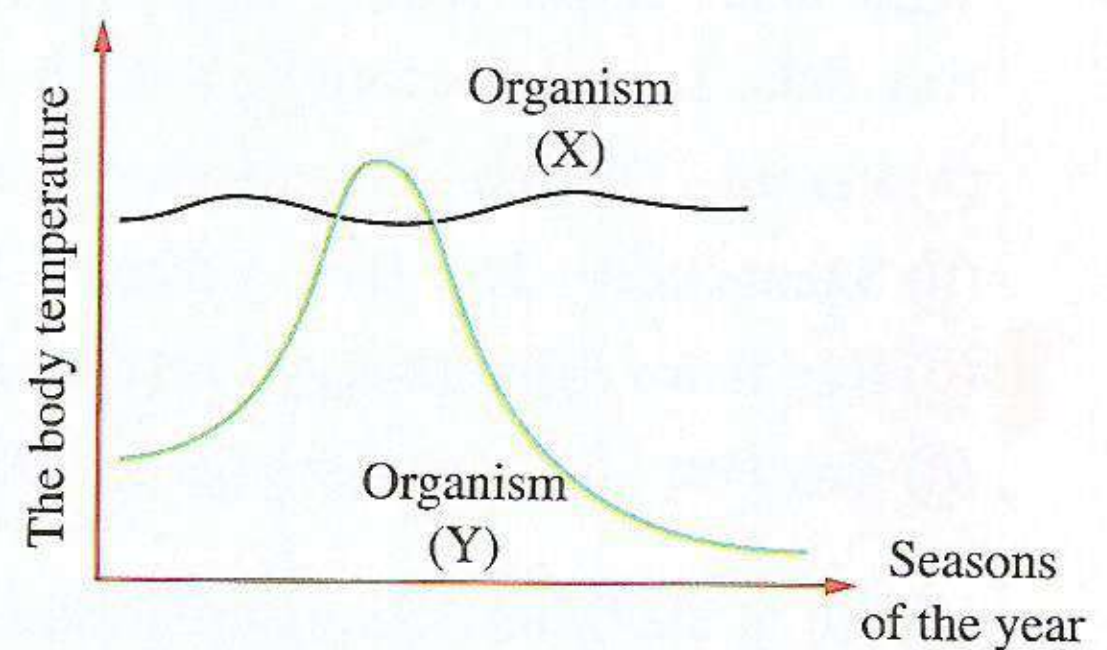
(a) individuals of group (X) only. (b) individuals of groups (X) and (Z).
(c) individuals of group (Y) only. (d) individuals of groups (Y) and (Z).

- (3) Which individuals of the following groups expected that their vital activity rate doesn't change by changing the year seasons ?

(a) Individuals of group (X) only. (b) Individuals of groups (X) and (Z).
(c) Individuals of group (Y) only. (d) Individuals of groups (Y) and (Z).

- 10 From the opposite graph, to which class the organisms (X) and (Y) belong respectively ?

(a) Aves and Mammalia.
(b) Chondrichthyes and Aves.
(c) Mammalia and Amphibia.
(d) Osteichthyes and Reptilia.



- 11 Chondrichthyes are characterized by all the following, except that

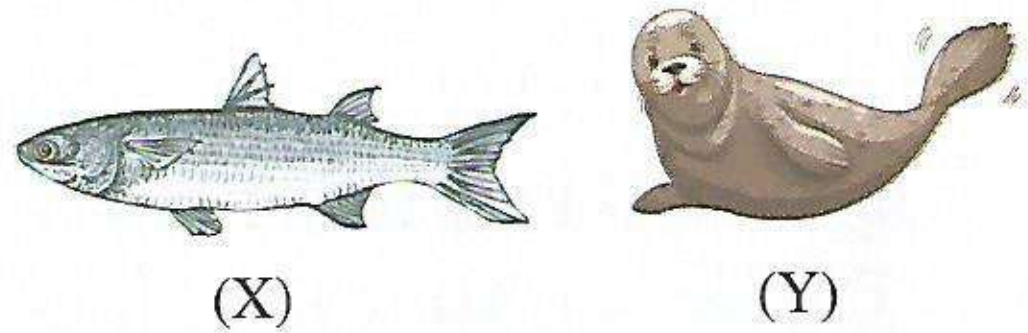
(a) their mouth has teeth.
(b) they have endoskeleton.
(c) they have an operculum.
(d) their body gain its temperature from water.

12 Lamprey, shark and pori are characterized by

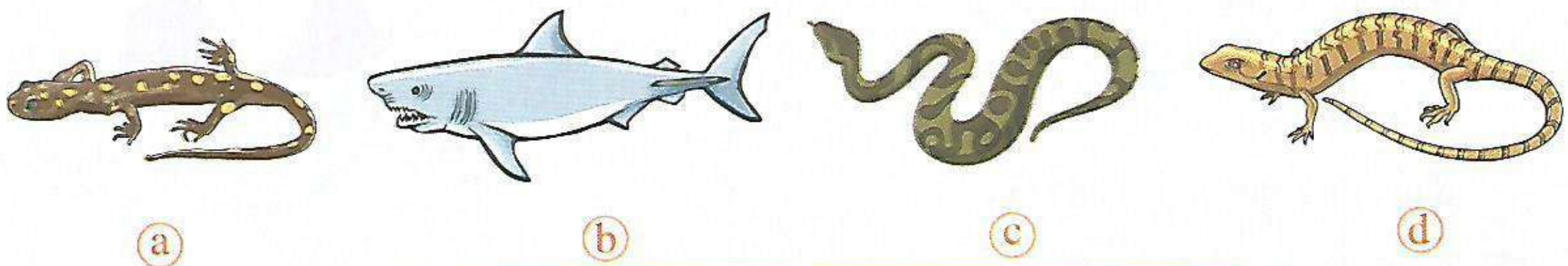
- (a) having paired fins.
- (b) having endoskeletons.
- (c) regulating their body temperature.
- (d) having medial fins.

13 The common character between organism (X) and organism (Y) is

- (a) the presence of an operculum.
- (b) the fertilization type.
- (c) the separation of sexes.
- (d) the ability to regulate the body temperature.



14 The skin is slimy and smooth in



15 Study the characteristics of the following organisms :

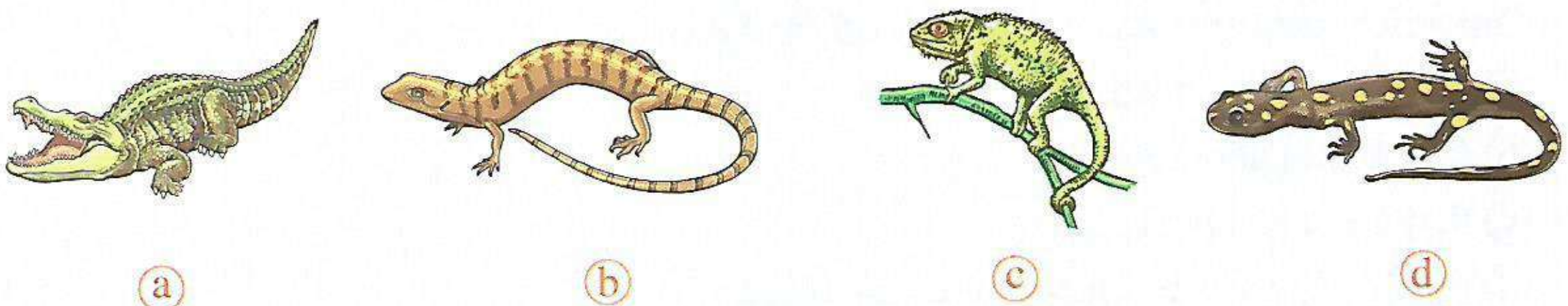
- **Organism (1)** : Its genetic material is found in the cytoplasm.
 - **Organism (2)** : Its cells contain green plastids and an eye spot.
 - **Organism (3)** : The female is viviparous and suckle its young.
- The kingdoms that include these organisms are respectively.

- (a) Monera / Plantae / Animalia
- (b) Protista / Plantae / Animalia
- (c) Monera / Protista / Animalia
- (d) Plantae / Fungi / Protista

16 What is the correct ascending arrangement of these organisms (Salamander - Ostrich - Ray fish - Lizard), according to their evolution ?

- (a) Lizard - Ostrich - Salamander - Ray fish.
- (b) Salamander - Ray fish - Lizard - Ostrich.
- (c) Ray fish - Salamander - Ostrich - Lizard.
- (d) Ray fish - Salamander - Lizard - Ostrich.

17 Which of the following organisms their adult stages breathe by skin and lungs ?



- 18 The body of lizard is covered with
 (a) chitinous cuticle. (b) calcareous shell. (c) horny scales. (d) bony scales.
- 19 Tortoise is different from toad in the
 (a) thermal equilibrium. (b) number of limbs.
 (c) number of toes. (d) type of fertilization.
- 20 All the embryonic stages of the following organisms breathe oxygen dissolved in water, except
 (a) frog. (b) salamander. (c) lizard. (d) ray fish.
- 21 The following animals are affected by the atmospheric temperature, except
 (a) ostrich. (b) salamander. (c) lizard. (d) ray fish.
- 22 All the following living organisms are viviparous, except the
 (a) whale. (b) duck-billed platypus.
 (c) kangaroo. (d) armadillo.
- 23 We can arrange the following animals ascendingly, according to their evolution, as
 (a) Duck-billed platypus - Armadillo - Kangaroo.
 (b) Armadillo - Kangaroo - Duck-billed platypus.
 (c) Kangaroo - Duck-billed platypus - Armadillo.
 (d) Duck-billed platypus - Kangaroo - Armadillo.
- 24 From the most higher animals that live in water is the
 (a) shark. (b) whale. (c) prawn. (d) pori (mullet).
- 25 Study the following table, then answer :

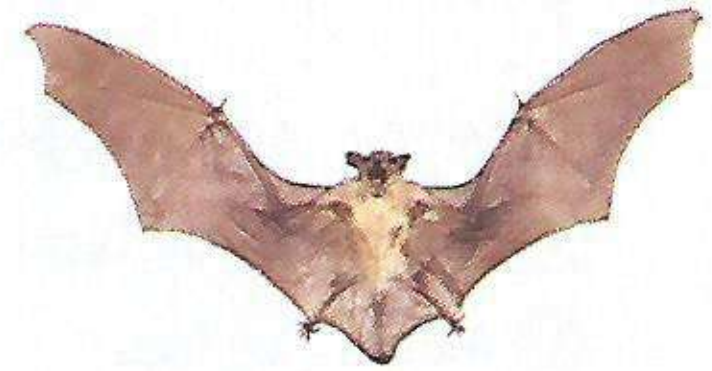
The character	Organism (A)	Organism (B)
The ability to fly	✓	✓
The number of toes	4	5

The organisms (A) and (B) belong to classes respectively.

- (a) Amphibia and Mammalia (b) Mammalia and Aves
 (c) Aves and Mammalia (d) Aves and Reptilia

26 What is the taxonomic standard upon which the opposite organism is classified among class Mammalia not class Aves ?

- (a) The habitat.
- (b) The method of respiration.
- (c) The type of fertilization.
- (d) The embryo's growth place.



27 From the common characteristics in all mammals is that

- (a) the mother gives birth to young.
- (b) the mother suckles its young.
- (c) the born individuals were fully developed.
- (d) the mother gives birth and suckles its young.

28 The whale is characterized by all the following, except that

- (a) its body temperature is constant.
- (b) the forelimbs are modified into paddle-like structures.
- (c) it breathes like the rest aquatic organisms.
- (d) the hind limbs are disappeared.

29 Rabbit shares squirrel in the

- (a) order that they belong to.
- (b) number of incisors in the upper jaw.
- (c) tail length.
- (d) number of incisors in the lower jaw.

30 Gerbo is characterized by all the following, except that [Choose two answers]

- (a) the upper jaw has a pair of sharp incisors.
- (b) the lower jaw has a pair of sharp incisors.
- (c) the tail is short.
- (d) the ears are small.
- (e) the brain is big.

31 Rhinoceros is different from deer in

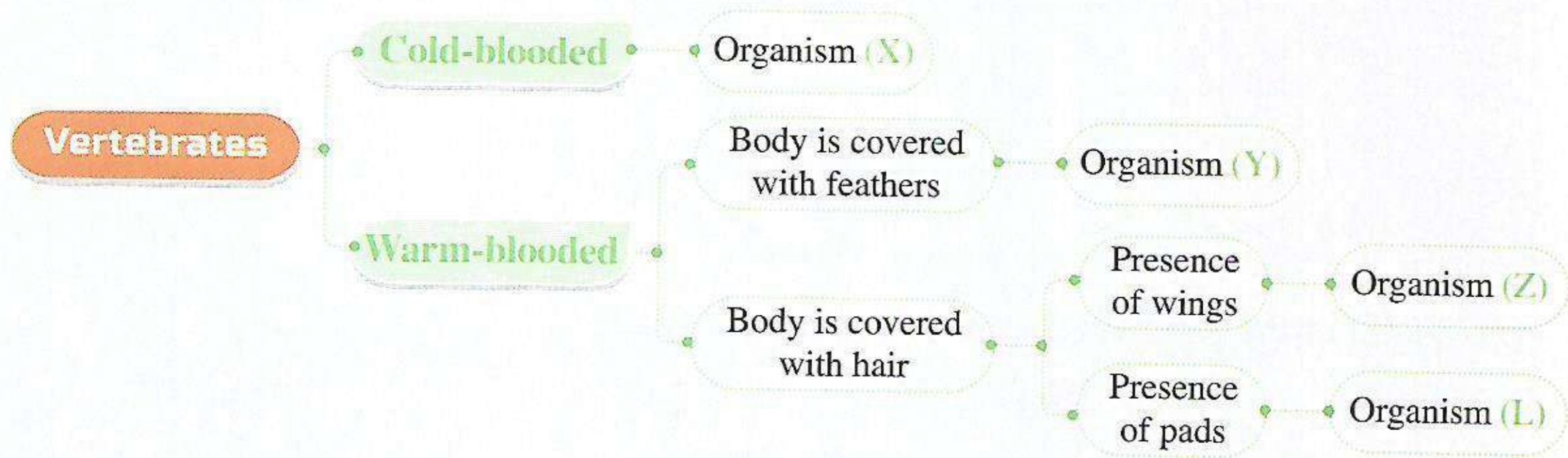
- (a) the mode of nutrition.
- (b) the number of limbs.
- (c) the number of toes.
- (d) the class that they belong to.

32 Bat is different from hawk in

- (a) the type of fertilization.
- (b) the modification of forelimbs.
- (c) the number of toes in the hind limbs.
- (d) the mean of locomotion.

- 33 Hedgehog is from the mammals that
- (a) lay eggs. (b) their young need care after birth.
(c) need to complete their growth after birth. (d) don't suckle their young.

- 34 From the following dichotomous key, answer :



- (1) Organism (X) doesn't belong to class
- (a) Mammalia. (b) Reptilia. (c) Amphibia. (d) Fishes.
- (2) Organism (Y) belongs to class
- (a) Mammalia. (b) Reptilia. (c) Amphibia. (d) Aves.
- (3) Organism (Z) is different from organism (L) in
- (a) the type of fertilization. (b) the mean of locomotion.
(c) the presence of mammary glands. (d) the sexes separation.
- 35 The rabbit is characterized by all the following, except that
- (a) it has a pair of incisors in the upper jaw.
(b) it has a pair of incisors in the lower jaw.
(c) the tail is short.
(d) the ears are long.
- 36 The is from the animals that can fly and suckle their young.
- (a) ostrich (b) hedgehog
(c) bat (d) duck-billed platypus
- 37 The stretching of the skin between the toes of the forelimbs is a characteristic feature for a mammal that
- (a) its hind limbs are disappeared. (b) is a protozoan animal.
(c) its young are immature. (d) is active during night.

- 38 ✎ The following table shows some characteristics of four different vertebrates (X), (Y), (Z) and (L), study it, then answer :

Character Organism	Hair	Wings	Laying eggs	Scales
(X)	X	X	✓	✓
(Y)	✓	X	✓	X
(Z)	X	✓	✓	X
(L)	✓	✓	X	X

Character present	✓
Character absent	X

- (1) Which of the following animals has spare storage of oxygen ?
 (a) (X). (b) (Y). (c) (Z). (d) (L).
- (2) Animal (Y) is different from animal (L) in
 (a) the type of fertilization. (b) the method of respiration.
 (c) the shape of limbs. (d) the type of blood.
- (3) Which of these animals is from the cold-blooded animals ?
 (a) (X). (b) (Y). (c) (Z). (d) (L).

Second

Miscellaneous Questions

- 1 **What** is the taxonomic standard upon which *Lamprey* is classified as class Agnatha ?

- 2 **What happens if** : reptiles are from warm-blooded animals ?

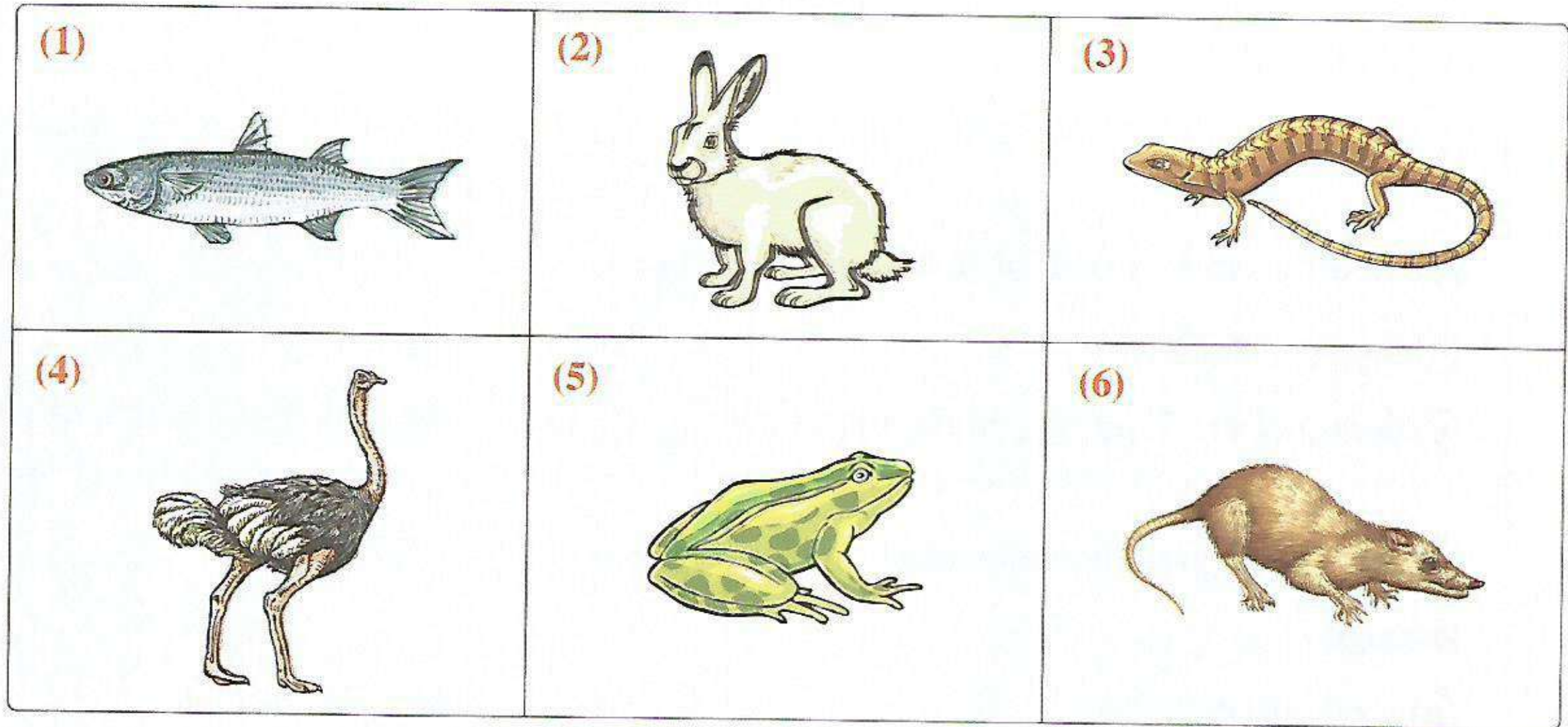
- 3 **What happens if** : the bones of the seagull become solid and the thoracic muscles become weak ? **Explain your answer.**

- 4 **What is the taxonomic standard upon which** :
 (1) Salamander is classified as Amphibia.
 (2) Crocodile is classified as Reptilia.

- 5 **Explain** : the adaptability of the internal structure of quail for flying.

- 6 ✎ **Deduce examples for living organisms that gather in their characters between** :
 (a) Different kingdoms. (b) Different classes.
Then, explain your answer.

7 Study the following figures, then determine :



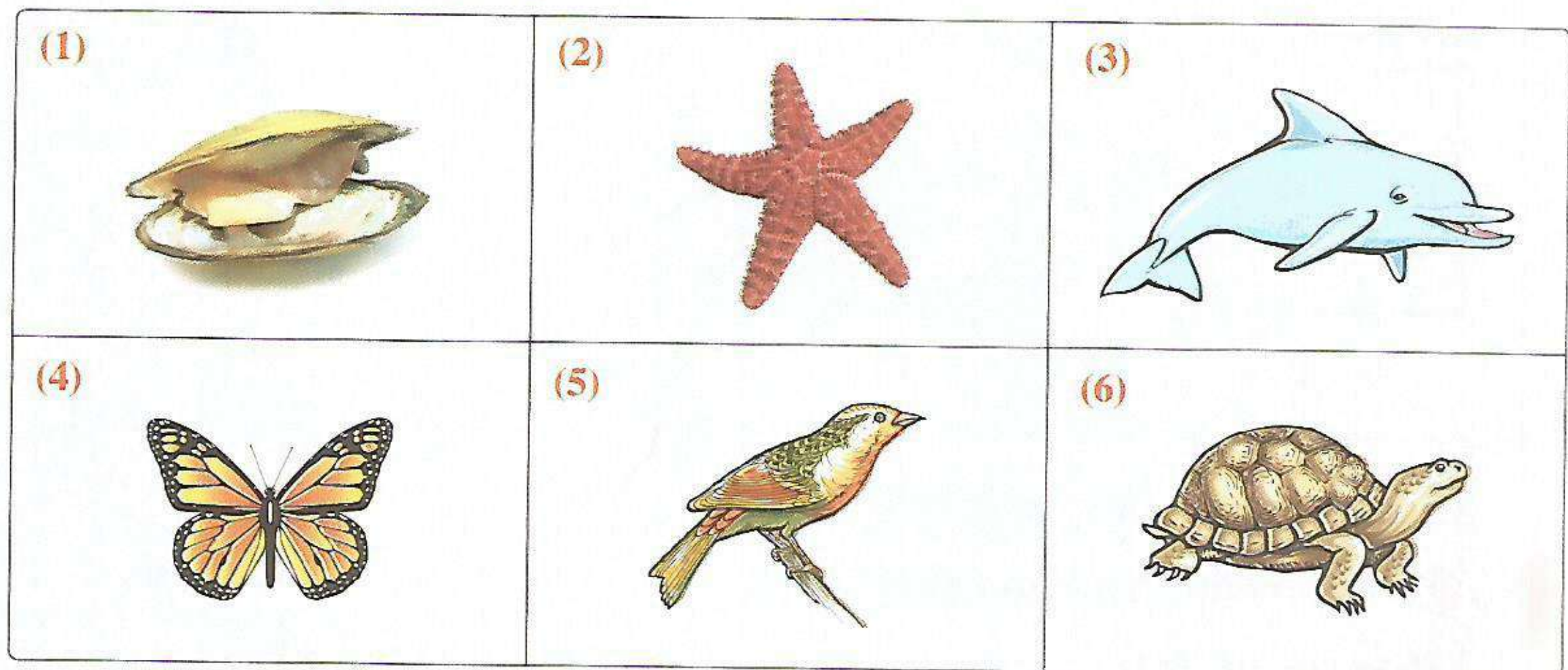
(a) The differences between :

1. Figure (1) and figure (5).
2. Figure (2) and figure (6).

(b) The similarities between :

1. Figure (2) and figure (4).
2. Figure (3) and figure (5).

8 Study the following living organisms, then :



(a) Mention the numbers of the organisms which belong to the phylum of the most higher living organisms.

(b) Mention the numbers of the organisms that contain endoskeletons.

9 What are the differences between : air sacs and air bladder ?

10 What happens in case of : the absence of the pouch that is found at the end of the kangaroo's abdomen ?

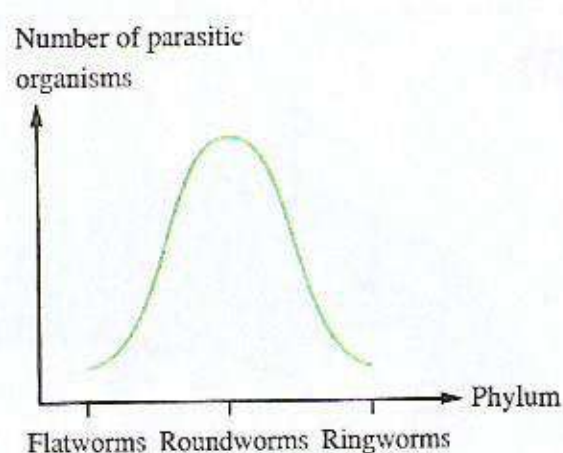


Choose the correct answer (1 : 10) :

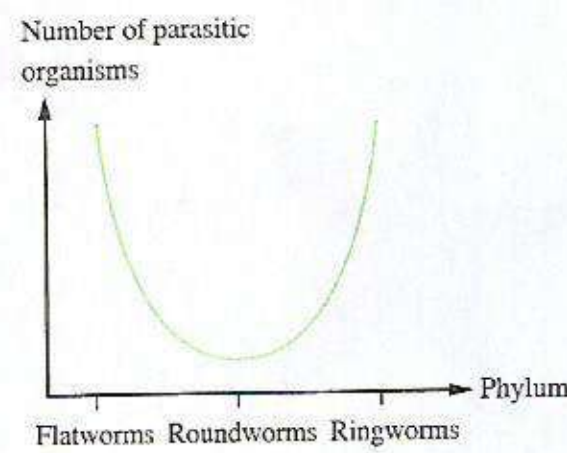
- 1 Rat is different from rabbit in all the following, except
- (a) the tail length. (b) the ear size.
- (c) the number of incisors in the upper jaw. (d) the number of incisors in the lower jaw.

- 2 We can distinguish between phylum Nematoda and phylum Annelida through
- (a) the body division. (b) the mode of living.
- (c) the sex. (d) the ability to move.

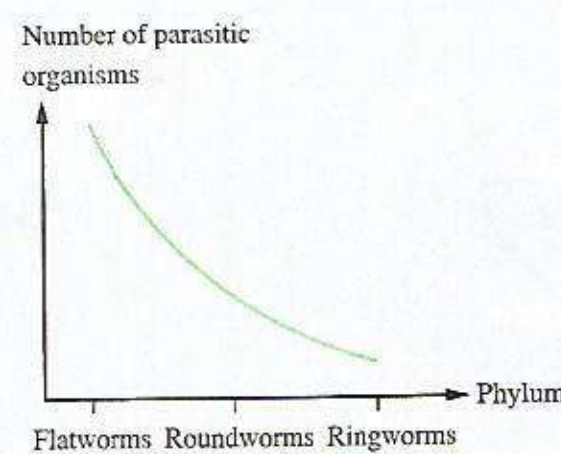
- 3 Which of the following graphs expresses the change in the number of parasitic organisms according to the three phyla illustrated in the graphs, using the modern classification system ?



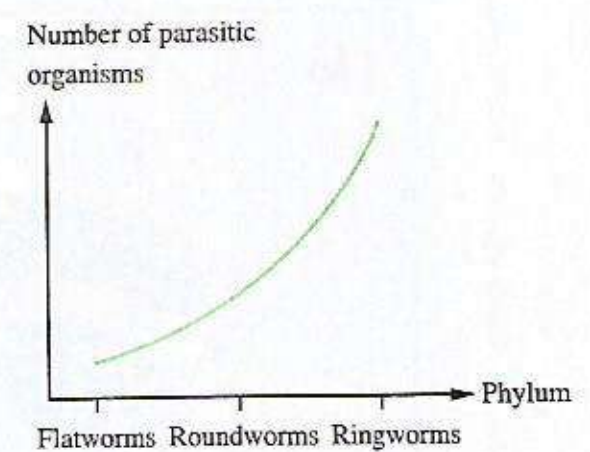
(a)



(b)



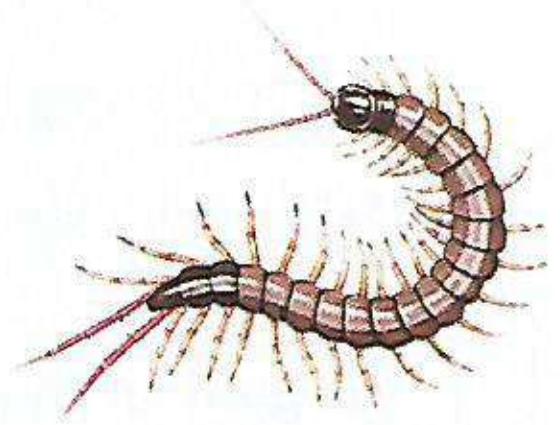
(c)



(d)

- 4 Class Insecta is similar to class Myriapoda in
- (a) the number of the body regions. (b) the method of respiration.
- (c) the number of legs. (d) the presence of wings.
- 5 If there is a living organism characterized by a body consists of two regions, which are the cephalothorax and abdomen. It breathes by gills and has many jointed appendages. So, this organism may be
- (a) spider. (b) scorpion.
- (c) locust. (d) crab.

6 The characteristic feature that distinguishes the organism shown in the opposite figure from the other organisms in its phylum is that



- (a) the body has appendages divided into several segments.
- (b) the body is covered by an exoskeleton.
- (c) the organism breathes by tracheoles.
- (d) the body is divided into head and trunk.

7 If there is an organism with segmented body and has spines that are buried in the skin. So, this organism may be

- (a) Earthworm.
- (b) *Planaria* worm.
- (c) *Bilharzia* worm.
- (d) tapeworm.

Study the following table, then answer :

	Prawn	Snake
The body cover		(1)
The way of obtaining O ₂	(2)	
The mean of locomotion		(3)

8 Number (1) indicates

- (a) bony scales.
- (b) horny scales.
- (c) moist skin.
- (d) chitinous cuticle.

9 Number (2) indicates

- (a) lungs.
- (b) gills.
- (c) tracheoles.
- (d) lung books.

10 Number (3) indicates

- (a) creeping.
- (b) swimming.
- (c) walking.
- (d) flying.

Answer the following questions (11 : 17) :

11 Four living organisms are found in the Red Sea which are (X), (Y), (Z) and (L) where :

- **Organism (X)** : is covered by bony scales and its mouth lies at the anterior tip of the body.
- **Organism (Y)** : is covered by a chitinous cuticle and has jointed appendages.
- **Organism (Z)** : is huge and breathes by two lungs.
- **Organism (L)** : is covered by scales that are similar to teeth and its mouth lies on the ventral surface of the head.

Classify each organism to its suitable class.

12 Compare between :

	Ray fish	Pori (Mullet) fish
The type of fertilization :	<hr/>	<hr/>
The type of endoskeleton :	<hr/>	<hr/>

13 Give reason for : in spite of the ability of bat to fly, it is classified from class Mammalia.

14 Explain : the bones of pigeon are hollow.

15 Determine the differences between :

Organisms (a) and (b), then mention which of them is more advanced.



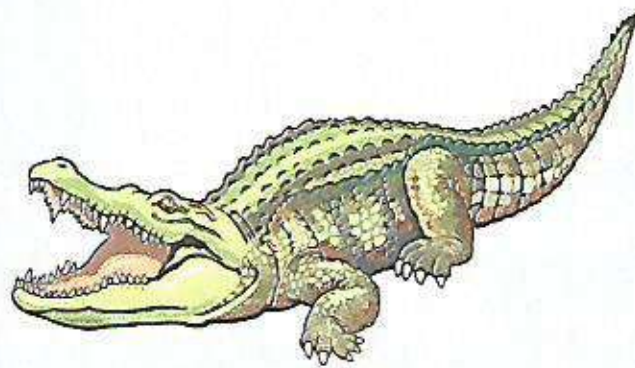
(a)



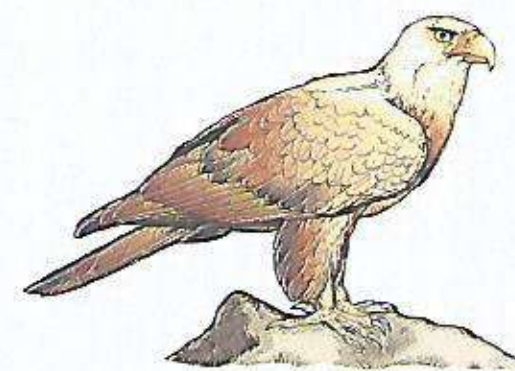
(b)

16 Write the name of two different species of living organisms which breathe by gills.

17 Mention a different character and a common one between the organisms (a) & (b) and between the organisms (c) & (d) :



(a)



(b)

The common character :



(c)



(d)

The common character :

10 MODEL EXAMS



Evaluate yourself through interactive exams by scanning this QR code.



And after finishing each exam, you can view a detailed report of your answers to evaluate yourself.




Model Exam

1

Choose the correct answer (1 : 10) :

1 Which of the following statements is wrong ?

- (a) The sperm is similar to the ovum in the number of autosomes.
- (b) The sperm is similar to the ovum in the number of sex chromosomes.
- (c) The sperm and the ovum contain half the number of chromosomes in the somatic cells.
- (d) The sperm and the ovum are responsible for the sex determination.

2  The opposite table shows the scientific name for two mammals (X) and (Y), if you know that the animal (X) is from the family Felidae. So, the

Scientific name	Animal
<i>Panthera leo</i>	(X)
<i>Panthera tigris</i>	(Y)

- (a) animal (Y) is from the same family.
- (b) animal (Y) has a genus name different from the animal (X).
- (c) individual resulted from mating (X) and (Y) doesn't carry any cats' characteristics.
- (d) individual resulted from mating (X) and (Y) carries all the cats' characteristics.

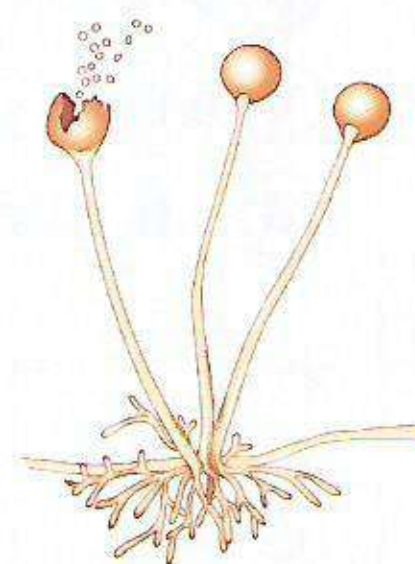
3 In fruit fly, the long-winged gene (W) dominates over the short-winged gene (w), what are the phenotypes of the parents according to the illustrated genotypes ?

- (a) Both parents are pure long-winged.
- (b) Both parents are hybrid long-winged.
- (c) One of the parents is short-winged and the other is pure long-winged.
- (d) One of the parents is short-winged and the other is hybrid long-winged.

♀ \ ♂	W	w
?	WW	Ww
?	Ww	ww

4 The opposite figure represents a living organism that belongs to division Zygomycota, because

- (a) it contains rhizoids.
- (b) it reproduces by producing spores.
- (c) it forms spores inside sporangia.
- (d) it is a multicellular organism.





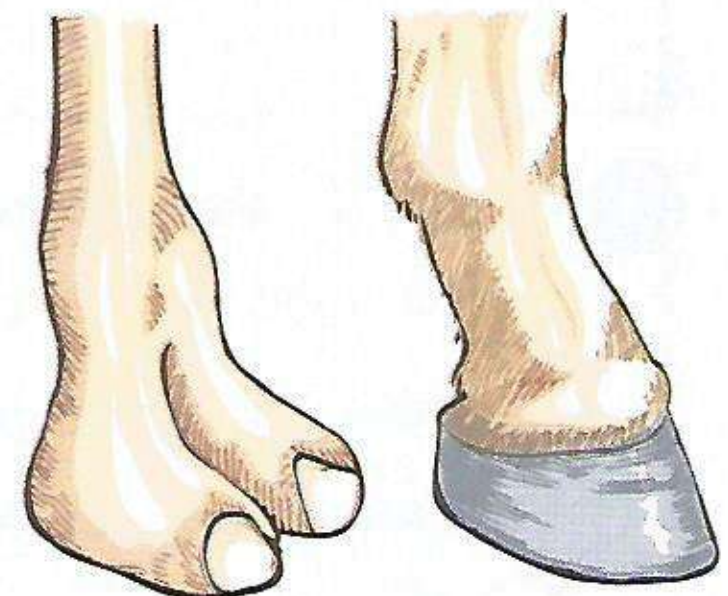
- 5 The inheritance of Rhesus factor (Rh) antigens is controlled by
- (a) two genes. (b) three genes. (c) four genes. (d) six genes.

- 6 All the following organisms don't obey the classification system of Whittaker, except
- (a) viroids. (b) corona virus.
(c) prions. (d) malaria *Plasmodium*.

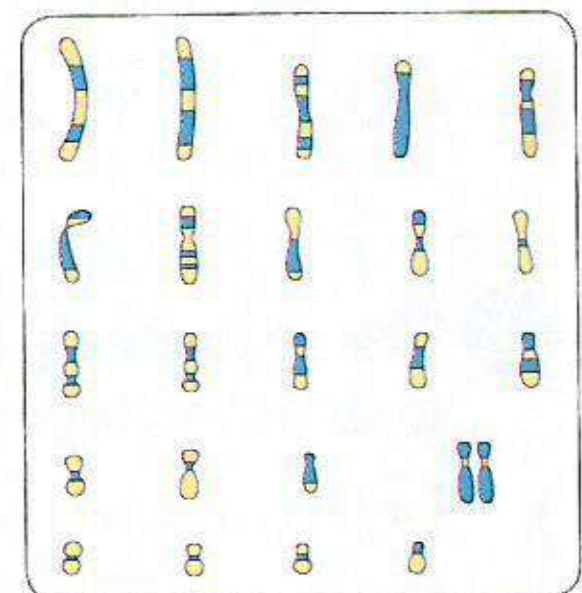
- 7 The dominant lethal factor can be distinguished from the recessive lethal factor by
- (a) the number of genotypes.
(b) the number of phenotypes.
(c) the ratio of dead individuals to the living ones.
(d) the ratio of genotypes of the living individuals.

- 8 The opposite figure represents legs of two mammals, which of the following statements is incorrect ?

- (a) Both of them have four pentadactyl limbs.
(b) Both of them are herbivorous animals.
(c) Both of them are viviparous animals.
(d) Mule is produced from their mating.



- 9 The opposite karyotype represents
- (a) a male gamete that results in a normal individual.
(b) a female gamete that results in a normal individual.
(c) a male gamete that results in an abnormal individual.
(d) a female gamete that results in an abnormal individual.



10 All the following organisms breathe by the two lungs, except the

- a whale.
- b crocodile.
- c embryonic stage of salamander.
- d adult stage of frog.

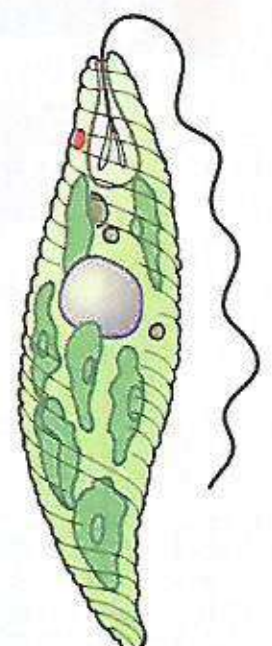
Answer the following questions (11 : 17) :

11 How is the abnormal case that carries the chromosomal structure (44 + XXX) produced ?

12 Explain : the spiny ant-eater isn't classified among the order Insectivora.

13 A person with blood group (A) wanted to donate blood to an injured person having the same blood group, after doing the crossmatching tests, the blood of the donor was refused, although the donor's blood is free from diseases. Discuss the possible reasons for rejecting the blood transfusion from the donor, despite the matching of the blood groups.

14 To which phylum does this living organism belong ?
With explaining the taxonomic standard upon which this organism belongs to that phylum.





- 15 What happens in case of : mating a black-feathered Andalusian cock with a white-feathered hen ? With explanation.

- 16 A farmer does cross-pollination between two pea plants, one of them has yellow-coloured seeds and the other has green-coloured seeds, the resulted plants in the first and second generations were as shown in the opposite table, knowing that yellow colour gene is symbolized by (Y) and green colour gene is symbolized by (y). In the light of this :

The generation	Seeds' colour	
	Yellow	Green
F ₁	632	Zero
F ₂	1500	492

- (a) Deduce the genotypes of the first and second generations.

- (b) Explain the results that are obtained in the second generation.
(Without genetic analysis)

- 17 What are the differences between : *Aurelia* and sea cucumber ? (2 points only)

<i>Aurelia</i>	Sea cucumber
<hr/>	<hr/>
<hr/>	<hr/>
<hr/>	<hr/>

Model Exam 2

Choose the correct answer (1 : 10) :

1. The somatic cells of the living organism differ from the gametes in all of the following, except
- the type of division from which they are produced.
 - the number of chromosomes that they carry.
 - the location of chromosomes in each of them.
 - the karyotype of each of them.
2. Two living organisms belong to the same phylum and differ in the order, therefore it is expected that they are classified under the same
- genus.
 - species.
 - class.
 - family.
3. When the sequence of nucleotides changes in DNA molecule, this leads to changing
- the number of chromosomes of the living organism.
 - the protein that is responsible for the appearance of a certain genetic character.
 - the karyotype of the living organism.
 - all genetic traits of the living organism.
4. A heterotrophic living organism that contains cell wall is
- lily plant.
 - yeast.
 - sponge.
 - Nostoc*.
5. In the opposite table, when crossing a pea plant carrying the genotype no. (2) with a plant carrying the same genotype, it is possible that some of the resulted individuals have genotypes identical to that of the individuals no.
- | ♀ \ ♂ | YS | Ys | yS | ys |
|-------|-------|-------|-------|-----|
| yS | ..... | (1) | ..... | (2) |
| ys | (3) | ..... | (4) | (5) |
- (1) and (3).
 - (1) and (4).
 - (3) and (5).
 - (4) and (5).



6 Which one of the following living organisms contains chromatophores in its cells ?



(a)



(b)



(c)



(d)

7 The blood group that receives blood from all the other groups is

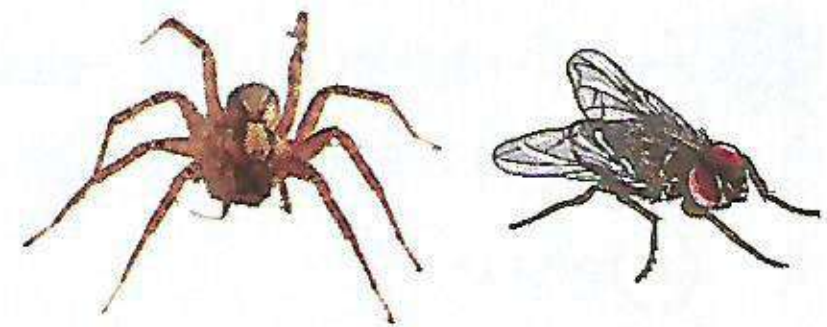
(a) (AB⁺).

(b) (AB⁻).

(c) (O⁺).

(d) (O⁻).

8 The two opposite figures represent two types of living organisms, where they share each other in



(a) the type of eyes.

(b) the number of body regions.

(c) the number of walking legs.

(d) the presence of exoskeleton.

9 After crossing two strains of pea flower (sweet pea) plant, all the flowers of the first generation were pink-coloured, because of

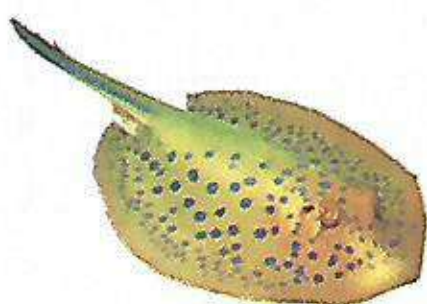
(a) the convergence of a pair of dominant genes with a pair of recessive genes.

(b) the convergence of a dominant gene with the other recessive genes.

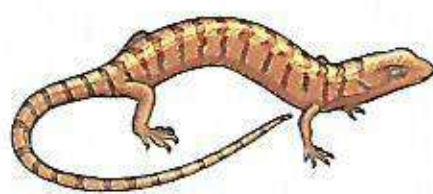
(c) the convergence of a dominant gene from each pair of the two pairs of genes.

(d) the convergence of all recessive genes together.

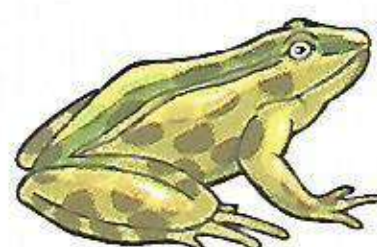
10 Which one of the following living organisms breathes by two different ways ?



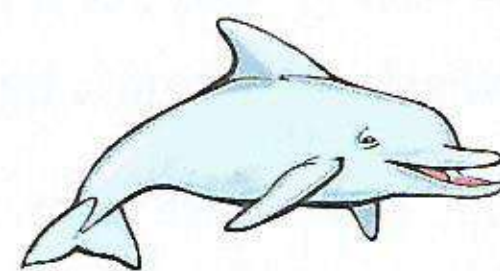
(a)



(b)



(c)



(d)

Answer the following questions (11 : 17) :







- 11 Explain : the haemophilia and colour blindness genes don't disappear from human beings.

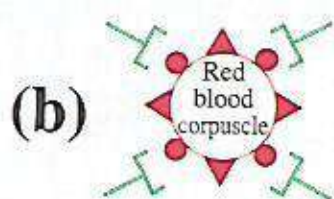
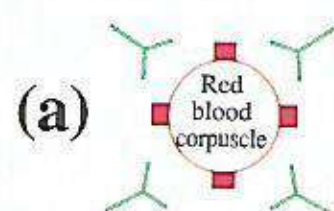
- 12 Arrange the following plants ascendingly from the lower to the higher advanced :
Onion / *Adiantum* / *Funaria* / *Pinus*

- 13 What happens if : the crossing between a red-eyed male of *Drosophila* insect and a white-eyed female of *Drosophila* insect occurs ? (Without genetic analysis)

- 14 Using the symbols in the opposite table :

Write down the type of blood group and Rhesus factor in each of the following figures :

		
Rh antigen	Antigen (B)	Antigen (A)
		
Rh antibody	anti-b	anti-a



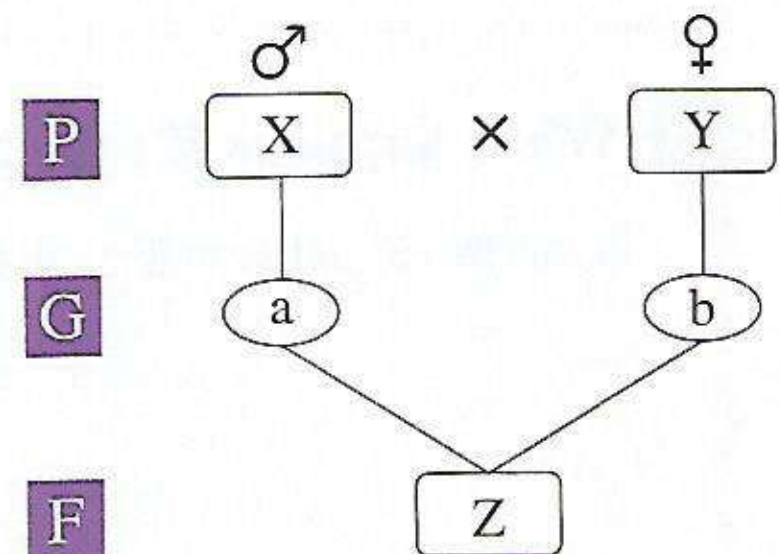
- 15 Correct this statement : "the crustaceans have radula".



16 What are the similarities and differences between : pigeon and bat ?

	Pigeon	Bat
Similarities :	<hr/> <hr/> <hr/>	
Differences :	<hr/> <hr/> <hr/>	<hr/> <hr/> <hr/>

17 The opposite figure illustrates the crossing between two types of odd-toed animals (X) and (Y), the somatic cells of each of them contain 62 and 64 chromosomes respectively :



(a) Deduce the animals (X), (Y) and (Z).

(b) Do you expect the production of a second generation from this crossing ? Explain your answer.

Model Exam 3

Choose the correct answer (1 : 10) :

1 Two pairs of chromosomes that are smaller than the pair no. (7) of chromosomes in human karyotype are the pairs no.

- a (5) and (6).
- b (6) and (8).
- c (6) and (23).
- d (8) and (23).

2 If you know that the scientific name of bean plant is *Vicia faba*, the two parts of the binomial name represent the

- a phylum and family.
- b family and order.
- c genus and species.
- d family and species.

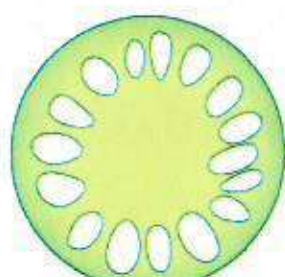
3 Which of the following statements is wrong ?

- a Blood group (AB^-) can be transfused to a sick person with blood group (AB^+).
- b Blood group (O^+) can be transfused to a sick person with blood group (AB^-).
- c Blood group (O^+) can be transfused to a sick person with blood group (AB^+).
- d Blood group (O^-) can be transfused to a sick person with blood group (AB^+).

4 Which of the following doesn't agree with the classification of plants that belong to the subclass Dicotyledons ?



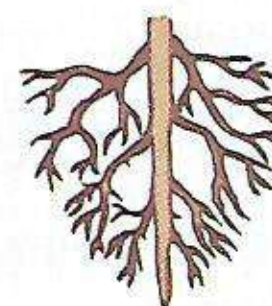
a



b



c



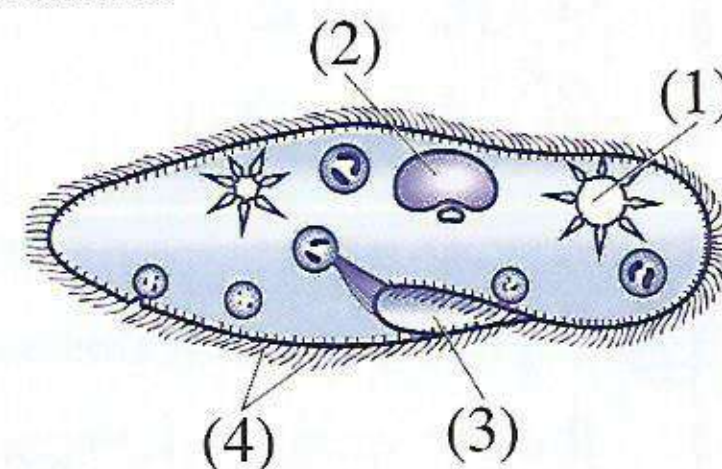
d



- 5 The number of chromosomes in a female with Down's syndrome equals their number in all the following, except
- a a male with Down's syndrome.
 - b a female with Turner's syndrome.
 - c the polyploidy (XXX).
 - d a male with Klinefelter's syndrome.

- 6 The opposite living organism feeds by the structure no.

- a (1).
- b (2).
- c (3).
- d (4).



- 7 If the percentage of gametes (SY) for an individual is 25%, its genotype is

- a SSYY
- b SSYy
- c SsYY
- d SsYy

- 8 As we move from phylum Platyhelminthes to phylum Nematoda till reaching phylum Annelida, we find that the

- a parasitism increases and the free-living character decreases.
- b parasitism decreases and the free-living character increases.
- c parasitism decreases and the predation increases.
- d free-living character decreases and the predation increases.

- 9 The chlorophyll pigment is formed in corn plant in case of

- a the presence of chlorophyll gene and in exposure to the light.
- b the absence of chlorophyll gene and exposure to the light.
- c the absence of chlorophyll gene and in exposure to the light.
- d the presence of chlorophyll gene and exposure to the light.

10 The living organism that contains the structure in the opposite figure is

- a) *Euglena*.
- b) *Chlamydomonas*.
- c) *Hydra*.
- d) *Paramecium*.



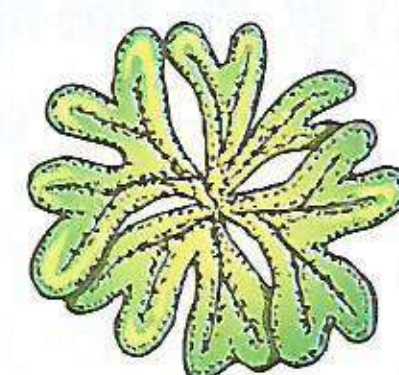
Answer the following questions (11 : 17) :

11 **Explain** : the modification of posterior limbs in Aves to adapt with the mode of life.

12 **Choose the anomalous word from each of the following :**

Character of milk production / Character of eggs laying / Character of beard appearance / Character of horns in cattles.

13 **To which** phylum does the opposite living organism belong ?

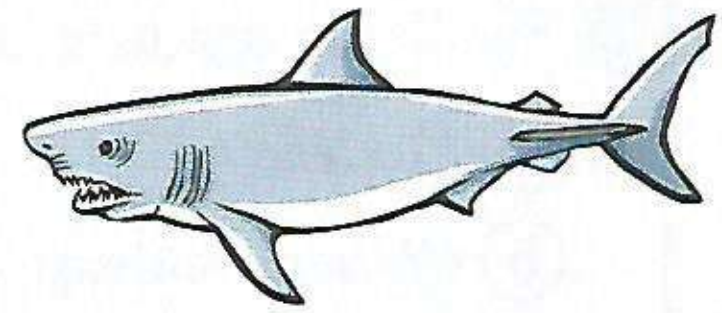


14 **Correct the mistake in the following statement :**

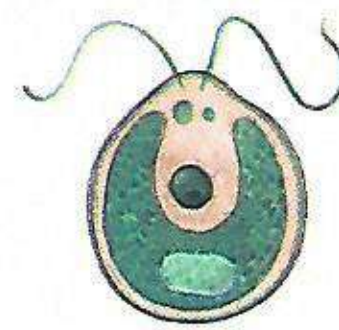
"The allelomorphic characters that disappear from the first generation and appear in the second generation express the case of complete dominance".



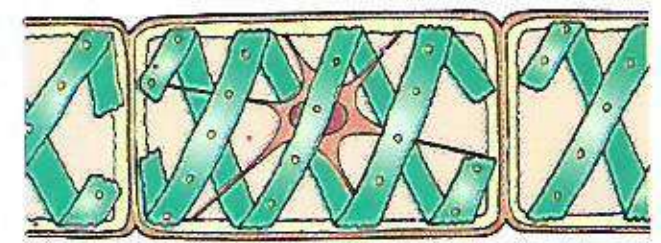
- 15** To which class does the opposite living organism belong ?
And what are the reasons upon which your answer is based through the examination of the external shape ?



- 16** In front of you, two types of living organisms no. (1) and (2) :
Show a similarity and a difference between them :



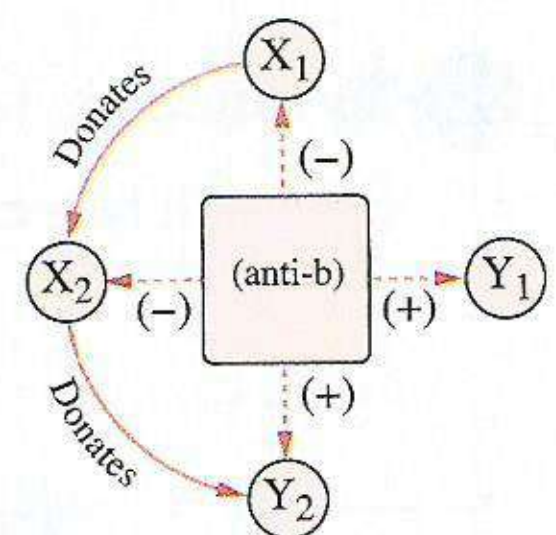
(1)



(2)

	Organism no. (1)	Organism no. (2)
Similarity :	<hr/>	
Difference :	<hr/>	<hr/>

- 17** The opposite figure shows the reaction of (anti-b) with blood groups symbolized by (Y_1 , Y_2 , X_1 & X_2), knowing that :
(+) represents agglutination.
(-) represents no agglutination.
(X_1) represents a universal donor.



- (a) Write what (X_2) and (Y_1) represent.

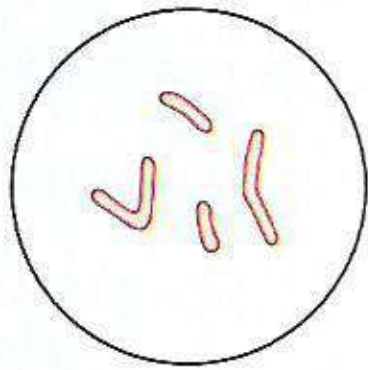
- (b) What is the possibility of the appearance of blood group (X_1) among children when crossing a woman with blood group (Y_2) with a man whose blood group is (X_1) ?

Model Exam

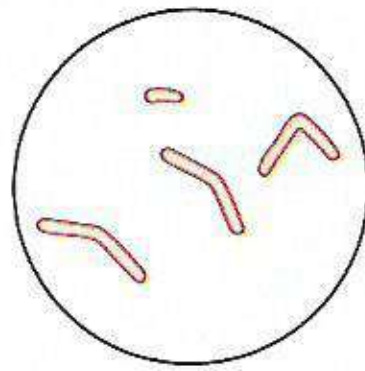
4

Choose the correct answer (1 : 10) :

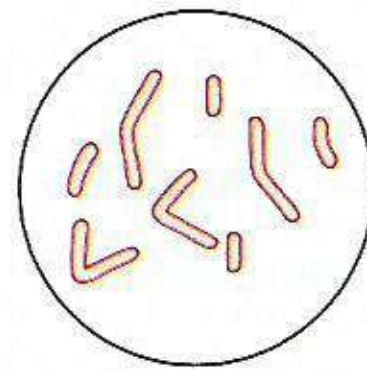
- 1 Which of the following figures shows the chromosomes in a nucleus of the produced cells from the mitotic division ?



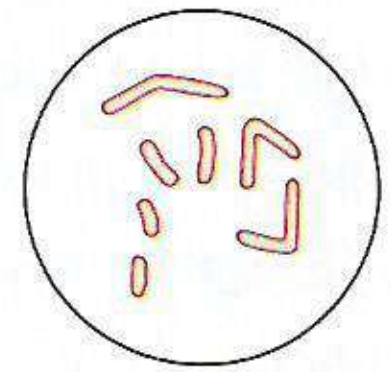
a



b



c



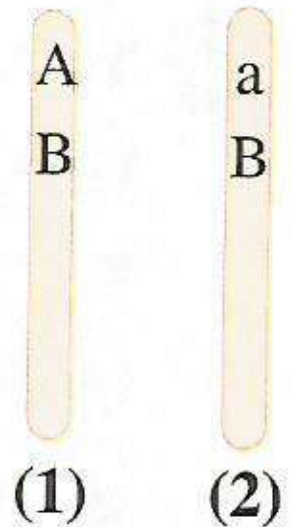
d

- 2 The correct sequence of the following living organisms from the lower advanced to the higher advanced is

- a monkey / squirrel / spiny ant-eater / kangaroo.
- b squirrel / kangaroo / spiny ant-eater / monkey.
- c spiny ant-eater / squirrel / kangaroo / monkey.
- d spiny ant-eater / kangaroo / squirrel / monkey.

- 3 The opposite figure represents a pair of chromosomes, the law of independent assortment of genetic factors isn't applied, because

- a the gene (A) doesn't dominate over the gene (B).
- b the gene (B) is in a dominant form.
- c the two chromosomes (1) and (2) don't separate during the gametes formation.
- d (A) and (B) genes are on the same chromosome.



(1)

(2)

- 4 All the following organisms get their food by the same method, except

- a *Plasmodium*.
- b leech.
- c *Aurelia*.
- d *Lamprey*.



- 5 The opposite table shows the genotypes for the fur colour in mice, when crossing a mouse no. (1) with a mouse no. (2). So, it is expected that the percentage of loss in the resulted offspring is

Mouse	No. (1)	No. (2)
Genotypes	Yy	yy

- (a) 0% (b) 25% (c) 50% (d) 75%

- 6 If you know that the number of chromosomes in the somatic cells of a female horse and a male donkey are 64 and 62 chromosomes respectively. So, the number of chromosomes in the somatic cells of mule is

- (a) 64 (b) 62 (c) 63 (d) 65

- 7 If you know that Rh antigen interacts with the antibody (anti-d), what is the expected blood group in the following table ?

First blood drop + (anti-a)	Second blood drop + (anti-b)	Third blood drop + (anti-d)	The expected blood group
Agglutination	No agglutination	Agglutination	.....

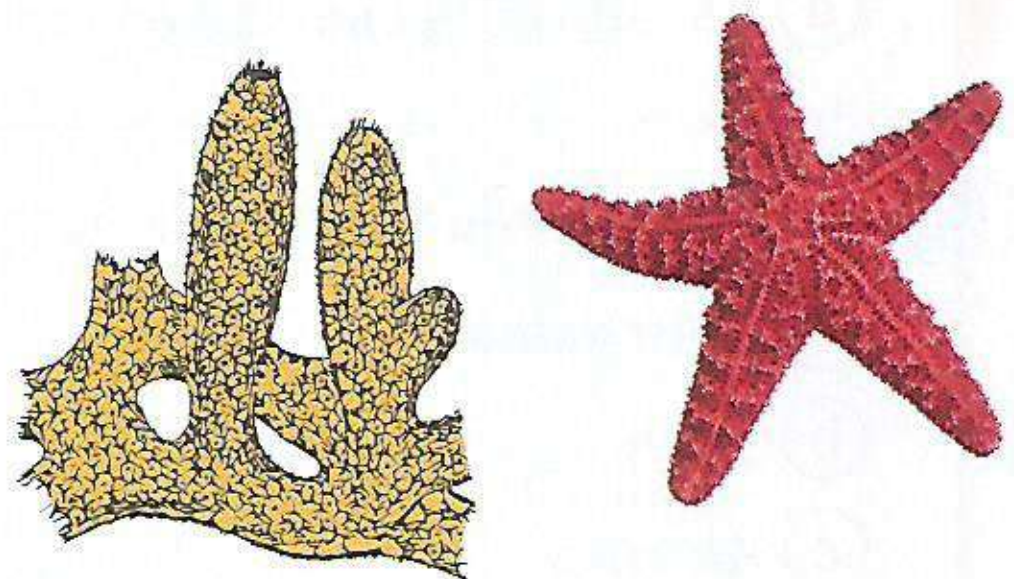
- (a) ARh⁺ (b) BRh⁺ (c) ARh⁻ (d) BRh⁻

- 8 The case in which the production of individuals carrying the dominant character may occur, when crossing among the individuals carrying recessive character takes place, is the case of

- (a) sex-linked genes. (b) complete dominance.
(c) complementary genes. (d) lack of dominance.

- 9 The opposite figures represent two invertebrates sharing together in

- (a) the body structure.
(b) the type of reproduction.
(c) the mean of locomotion.
(d) the genus.



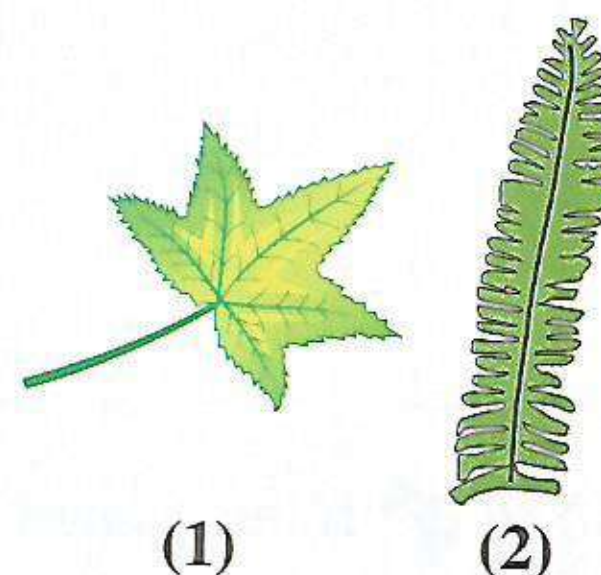
- 10 ✎ If a pure bald male appeared in the offspring. So, it is confirmed that
- (a) the mother suffers from hair falling.
 - (b) the father has normal hair.
 - (c) the mother doesn't carry the baldness gene.
 - (d) the father suffers from the baldness.

Answer the following questions (11 : 17) :

- 11 Explain : the individuals may have the same phenotype, although they have different genotypes.

- 12 In front of you, two leaves of two types of plants.

Determine the class that each of them belongs to.



- 13 "Some types of plants can be identified through the examination of their flowers".
Discuss the statement.

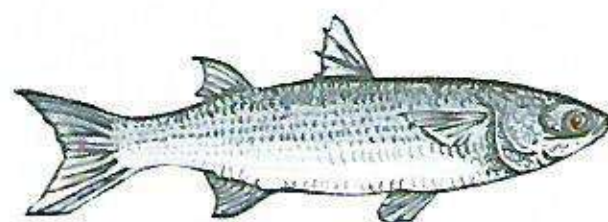
- 14 In a strain of ornamental sparrows, if there are yellow-feathered sparrows, red-feathered sparrows and orange-feathered sparrows, knowing that the orange-feathered sparrows achieve a higher financial revenue when selling them.
How can you achieve the highest financial revenue ? (Without genetic analysis).



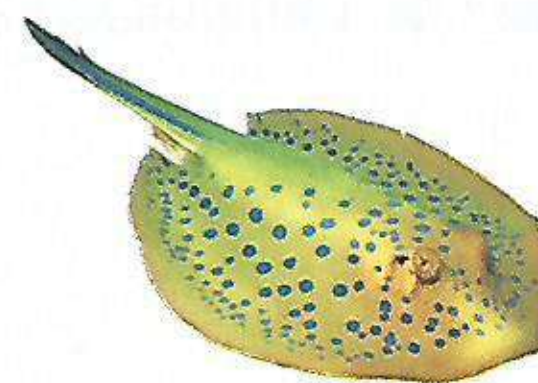
15 What are the differences between : the air bladder and air sacs ?

Air bladder	Air sacs

16 Show : two differences between the two living organisms no. (1) and (2) after examining each one.



(1)



(2)

17 If the gene of the brown-coloured eyes (B) in human dominates over the blue-coloured eyes gene (b) and the colour blindness is a sex-linked trait, where its genes are carried on the sex chromosome (X),

based on the opposite table :

Write the genotypes and phenotypes of individuals (1), (2), (3) and (4).

♀ \ ♂	$B^c X$	BY	$b^c X$	bY
$b^c X$	(1)	.....	(2)	.....
$B^c X$	.....	(3)	.....	(4)

Model Exam 5

Choose the correct answer (1 : 10) :

1 The two opposite figures show the sex chromosomes in a somatic cell in human, which of them is present in the adult female gamete ?

- a Both (1) and (2).
- b (1) or (2).
- c (1) only.
- d (2) only.



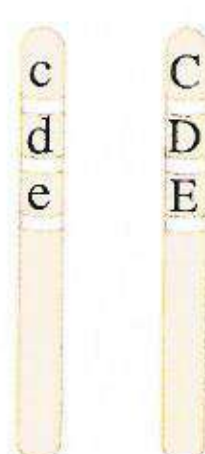
2 Each group in the levels of the taxonomic hierarchy includes

- a smaller numbers of organisms that share more common traits than the following group.
- b smaller numbers of organisms that share less common traits than the previous group.
- c greater numbers of organisms that share more common traits than the previous group.
- d greater numbers of organisms that share less common traits than the following group.

3 If you know that the genes (C, D and E) are responsible for the inheritance of (Rh) factor, where they dominate over the genes (c, d and e) respectively. So, which of the following pairs of chromosomes are present in the mother that needs antiserum after giving birth to a child with (Rh⁺) ?



a



b



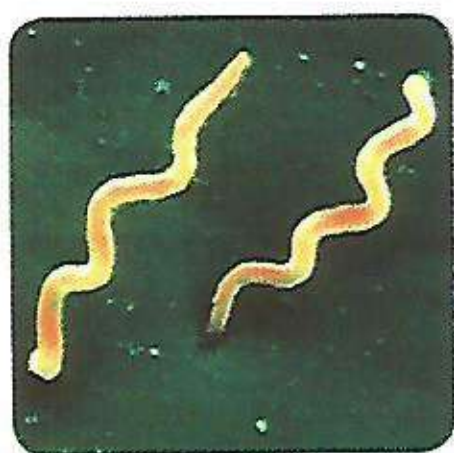
c



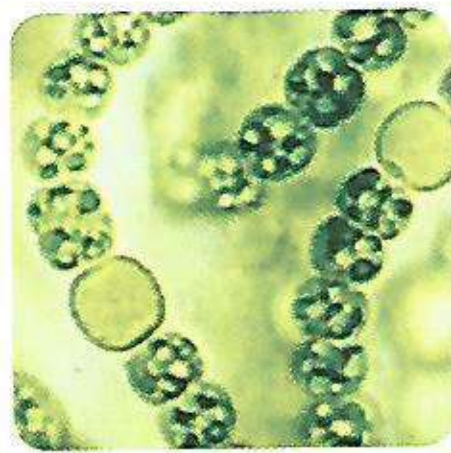
d



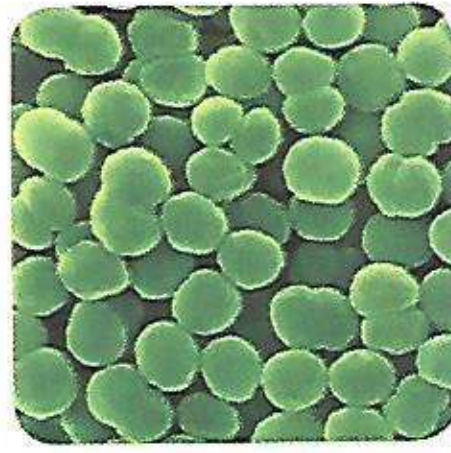
- 4 All the following living organisms whose cytoplasm contains a genetic material that is not surrounded by the nuclear envelope, except



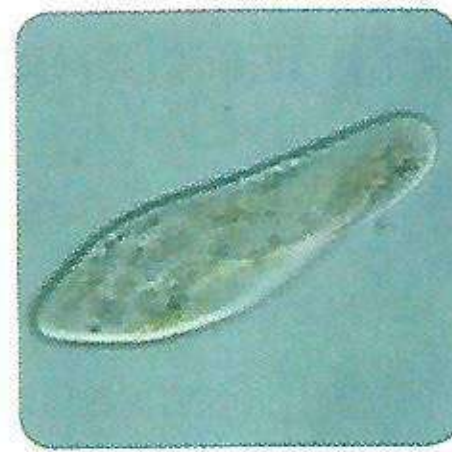
(a)



(b)



(c)



(d)

- 5 If a crossing occurs between two heterozygous parents in one pair of mendelian characters. So, the ratio of the resulted genotypes is

- (a) 3 : 1
- (b) 1 : 2 : 1
- (c) 9 : 3 : 3 : 1
- (d) 9 : 7

- 6 All the following living organisms contain green plastids (chloroplasts), except

- (a) diatoms and sponge.
- (b) *Euglena* and *Spirogyra*.
- (c) *Polysiphonia* and *Chlamydomonas*.
- (d) *Riccia* and *Polypodium*.

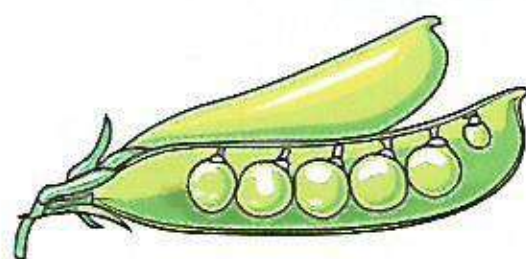
- 7 If the genotype ($B^+B^+X^CXY$) appears among the children, the possible genotypes of the parents are

- (a) $B^+B^+X^CY \times B^+B^+X^CX^C$
- (b) $BB^+X^CY \times B^+B^+X^CX^C$
- (c) $BB^+X^CY \times B^+B^+X^CX^C$
- (d) $BB^+X^CY \times B^+B^+X^CX^C$

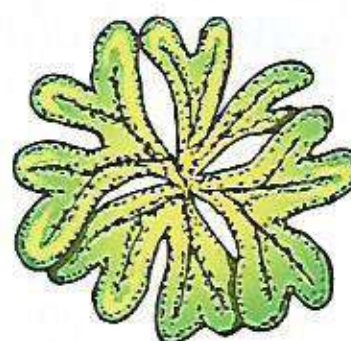
8 Which of the following plants doesn't contain xylem tissue ?



(a)



(b)



(c)

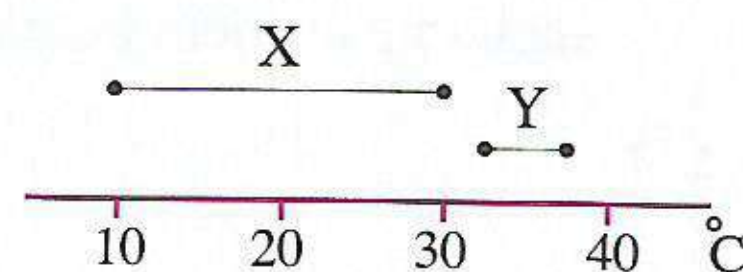


(d)

9 In males, the phenotype expresses the genotype in the traits.

- (a) dominant lethal
- (b) sex-linked
- (c) sex-influenced
- (d) mendelian

10 The opposite figure illustrates the thermal range of the body temperature for two different species of animals (X) and (Y). In the light of your understanding for the thermal equilibrium, you can conclude that



- (a) (X) is from cold-blooded animals and (Y) is from warm-blooded animals.
- (b) (X) is from warm-blooded animals and (Y) is from cold-blooded animals.
- (c) each of (X) and (Y) is from cold-blooded animals.
- (d) each of (X) and (Y) is from warm-blooded animals.

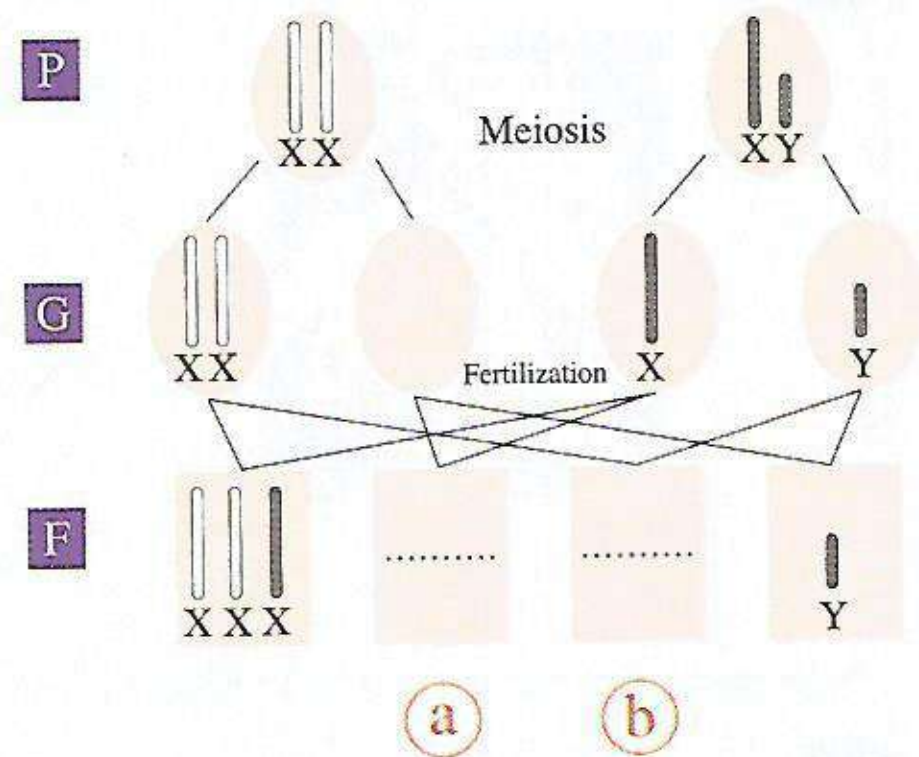
Answer the following questions (11 : 17) :

11 "The structure of the cell wall differs from a kingdom to another in the living organisms". **Explain this.**

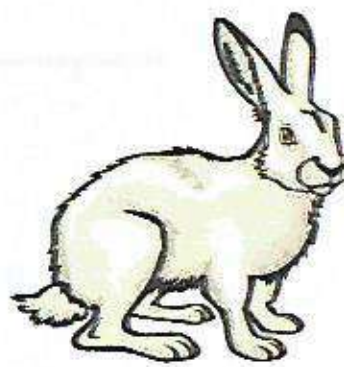


- 12 The opposite figure shows the genetic analysis of some abnormal chromosomal cases in human :

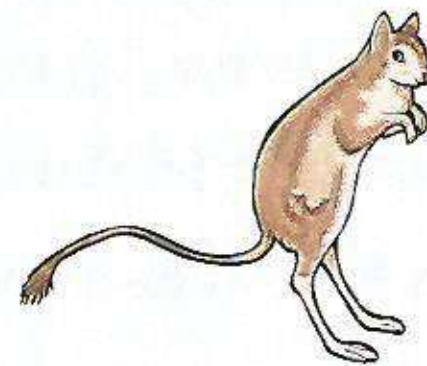
Deduce the name of (a) and (b) cases.



- 13 The following figures show two species of living organisms. Determine to which order each one of them belongs, then illustrate the differences between them.



(1)

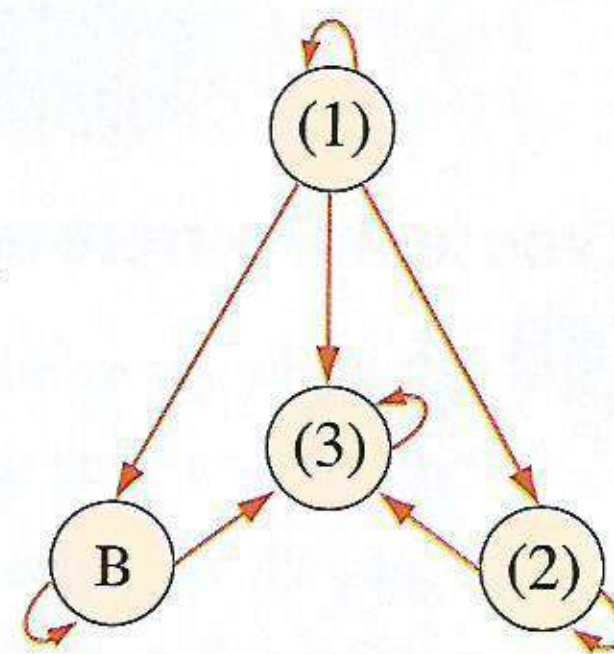


(2)

- 14 What happens in case of : the inheritance of infantile dementia gene from one of the parents ?

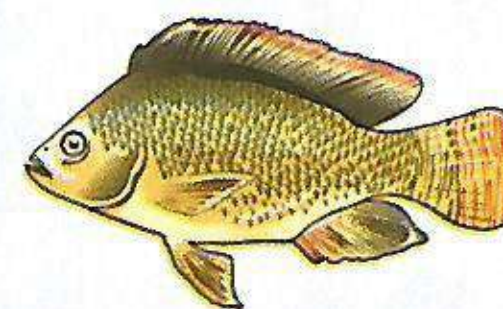
15 Using the opposite diagram :

An accident happened to a person resulted in severe bleeding, where his father's blood group is no. (2) and his mother's blood group is no. (3), and the parents couldn't donate blood to him. **Explain this, then illustrate** the blood groups that could be transfused to that person.



16 To which class does the opposite fish belong ?

What are the standards that your answer based on through your examination for the external shape ?



17 Write what the following statement indicates :

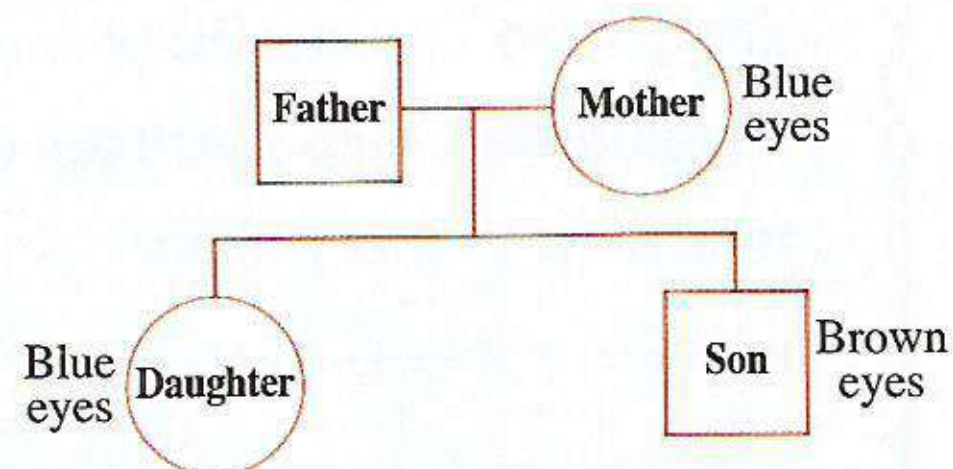
"An odd-toed animal that is unable to mate and reproduce".



Model Exam 6

Choose the correct answer (1 : 10) :

- 1 In the opposite figure, if you know that the brown eyes gene dominates over the blue eyes gene, what do you expect to be the colour of the father's eyes ?



- a Blue.
- b Hybrid brown.
- c Pure brown.
- d New character.

- 2 From the prokaryotic autotrophs is

- a *Euglena*.
- b *Nostoc*.
- c *Riccia*.
- d *Chlamydomonas*.

- 3 The two scientists Sutton and Boveri have a role in genetics through

- a determining the structure of DNA
- b explaining the sex-linked traits.
- c explaining the effect of environment on the phenotypes of the living organism.
- d studying the characteristics of chromosomes.

- 4 *Funaria* shares bread mould fungus in that each of them

- a is heterotrophic.
- b reproduces asexually by regeneration.
- c contains rhizoids.
- d consists of filaments adhering together by a gelatinous membrane.

5 When crossing a colour-blinded woman with a healthy man, it is assured that

- (a) all the sons are healthy.
- (b) the son has the same phenotype of the father.
- (c) all the daughters are healthy.
- (d) the daughter has the same genotype of the mother.

6 From fungi that their spores are formed inside sporangia is fungus.

- (a) bread mould
- (b) mushroom
- (c) *Penicillium*
- (d) yeast

7 All the following hereditary cases in which the phenotype indicates the genotype, except

- (a) yellow-coloured fur mice.
- (b) grey-coloured fur mice.
- (c) green seedlings of the corn plant.
- (d) colour blindness in males.

8 Camel belongs to the order

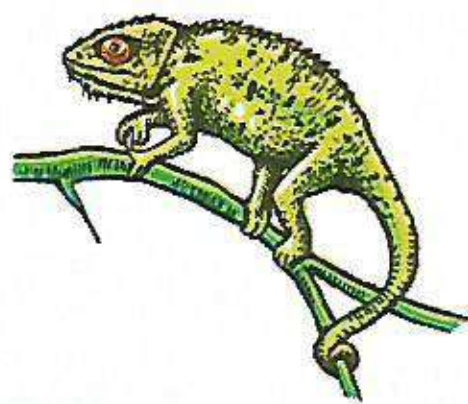
- (a) Carnivora.
- (b) Perissodactyla.
- (c) Artiodactyla.
- (d) Primates.

9 The genes controlling the inheritance of (Rh) factor don't obey the law of independent assortment of genetic factors, because they

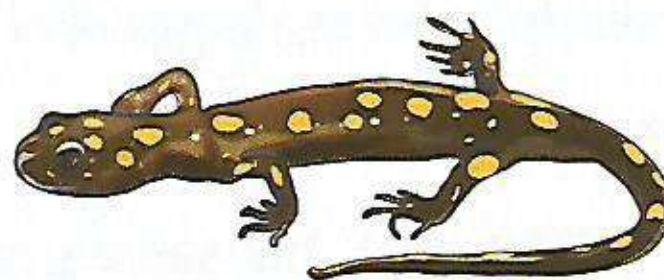
- (a) are found on one pair of chromosomes.
- (b) are carried on a sex chromosome.
- (c) determine the type of the blood group.
- (d) are found on different chromosomes.



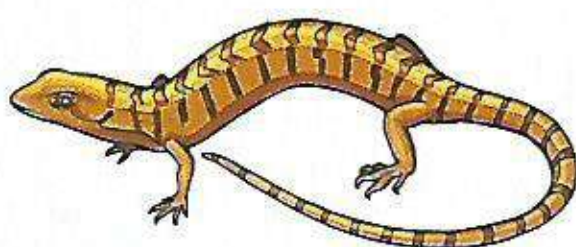
10 The following living organisms in which the fertilization is internal, except



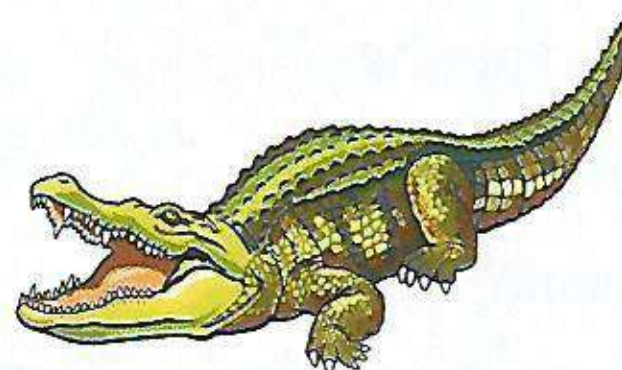
a



b




c





d

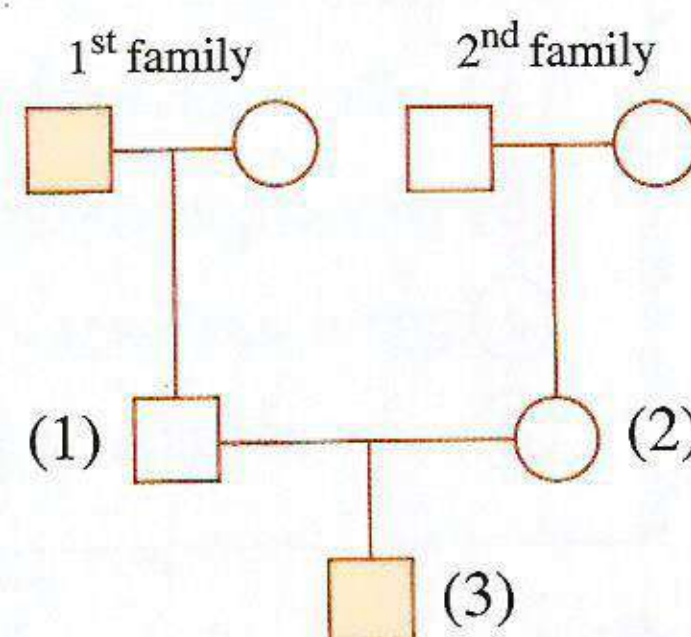
Answer the following questions (11 : 17) :

11 In the opposite figure :

 represents a male suffering from haemophilia.

 represents a healthy male.

 represents a healthy female.



When crossing no. (1) with no. (2), the disease appeared on the grandson (3).

From which family does the grandson inherit this disease ? Explain your answer.

- 12 The opposite figure illustrates one of the living organisms which live in the alimentary canal of human, **determine** the type of the cell in this organism (prokaryotic or eukaryotic). **Explain your answer.**

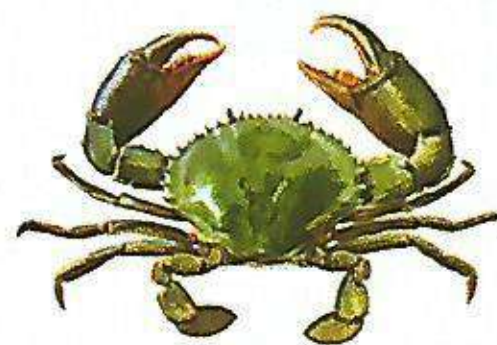


- 13 Write the genotypes for the following phenotypes :

(a) Blue-feathered Andalusian cock.

(b) Green pea plant having hybrid yellow-coloured and wrinkled seeds.

- 14 The opposite figures illustrate two invertebrates, **determine the similarities and differences between them.**



(1)



(2)

	Animal (1)	Animal (2)
Similarities :	<hr/> <hr/> <hr/>	
Differences :	<hr/> <hr/> <hr/>	<hr/> <hr/> <hr/>



- 15** What happens if : a human female ovum devoid of sex chromosomes is fertilized by a sperm carrying chromosome (X) ?

- 16** Explain : the sponge is classified as an animal, although it is immobile.

- 17** "The effect of some genes depends on the internal and external environmental factors surrounding the individual". **Discuss the statement.**

Model Exam 7

Choose the correct answer (1 : 10) :

1 Chromosomes can be studied through samples from all the following, except

- (a) white blood corpuscles. (b) nerve cells.
(c) red blood corpuscles. (d) skin.

2 All the following plants form seeds, except

- (a) cactus. (b) *Pinus*.
(c) cotton. (d) *Polypodium*.

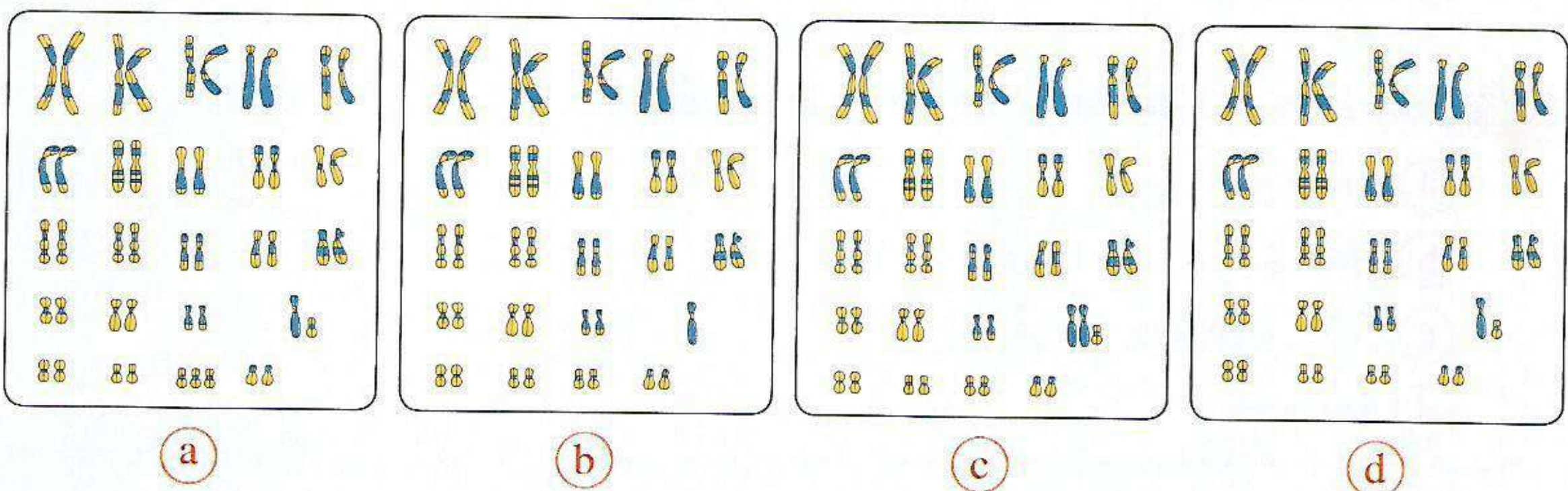
3 If a crossing occurs between two green pea plants that have a heterozygous pair of genetic traits and the resulted offspring contains 200 plants. So, the number of heterozygous plants is about

- (a) 50 (b) 100 (c) 150 (d) 200

4 Which of the following statements is wrong ?

- (a) Majority of mammals suckle their young. (b) Some mammals lay eggs.
(c) All mammals have canines. (d) All mammals breathe by lungs.

5 Which of the following karyotypes doesn't express an abnormal chromosomal case in human ?





- 6 Which of the following living organisms whose body contains a gastrovascular cavity ?



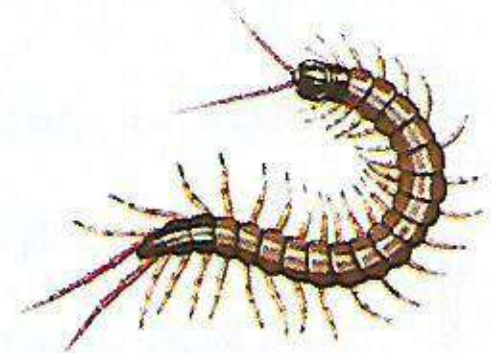
(a)



(b)



(c)



(d)

- 7 The ratio between the number of phenotypes for the dominant lethal genes to the recessive lethal genes when a crossing among hybrid individuals takes place is respectively.

(a) 1 : 1

(b) 2 : 1

(c) 1 : 2

(d) 1 : 3

- 8 Bony fishes differ from the adult stage of amphibians in the

- (a) sex separation.
- (b) type of fertilization.
- (c) method of respiration.
- (d) thermal equilibrium.

- 9 The eggs laying trait in females is considered an example for traits.


- (a) sex-linked
- (b) sex-influenced
- (c) sex-limited
- (d) mendelian

- 10 The means of locomotion are varied in phylum

- (a) Porifera.
- (b) Mollusca.
- (c) Echinodermata.
- (d) Amphibia.

Answer the following questions (11 : 17) :

- 11** You have a pea plant with smooth shaped-seeds. **How can you recognize its genotype (hybrid or pure) ?**

- 12**  Two parents gave birth to a child with blood group (O^-), if you know that the father's blood group is (A^+) and the mother's blood group is (B^+). **Explain this without genetic analysis.**

- 13 Give reason for :** despite the presence of hard endoskeleton in the sea star, it is not classified as a vertebrate.



14 Compare between : radula and foot "in Mollusca".

Radula	Foot

15 What happens in case of : the absence of chromosome (Y) in a normal human embryo during the early growth stages ?

16 How far this statement is correct, with explanation :
"All the living organisms that belong to kingdom Protista are autotrophs".

17 To which phylum does the opposite living organism belong ?

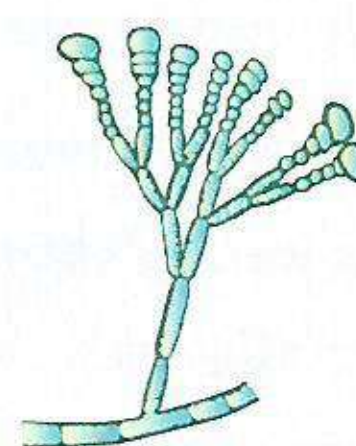


Model Exam

8

Choose the correct answer (1 : 10) :

- 1 When a crossing between two green pea plants takes place, the resulted generation contains long and short-stemmed plants with equal ratios. So, the parents' genotype is
- (a) $tt \times tt$ (b) $Tt \times tt$
(c) $TT \times tt$ (d) $Tt \times Tt$
- 2 The correct sequence of the following living organisms from the lower advanced to the higher advanced is
- (a) *Polypodium* / *Riccia* / diatoms / *Nostoc*.
(b) diatoms / *Riccia* / *Polypodium* / *Nostoc*.
(c) *Nostoc* / diatoms / *Riccia* / *Polypodium*.
(d) *Riccia* / *Nostoc* / diatoms / *Polypodium*.
- 3 Each of somatic cell nucleus and male gamete nucleus in human contains all the following respectively, except
- (a) $(2n)$ and (n) chromosomes.
(b) 46 molecules of DNA and 23 molecules of DNA
(c) 46 chromosomes and 23 chromosomes.
(d) 44 chromosomes and 22 chromosomes.
- 4 The living organism (X) shares the living organism (Y) in that both of them
- (a) belong to the same division.
(b) are formed of segmented hyphae.
(c) contain a mean of locomotion.
(d) contain spores inside asci.



(X)



(Y)



5 If two individuals that have pure allelomorphic traits get married, their characters don't appear on the resulted offspring. So, it is possible that this case is

- (a) complete dominance.
- (b) lack of dominance.
- (c) complementary genes.
- (d) lethal genes.

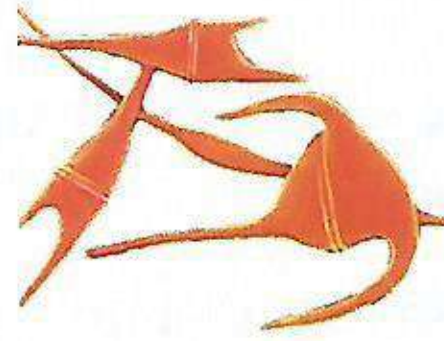
6 Which of the following living organisms is not considered from the higher algae ?



(a)



(b)



(c)



(d)

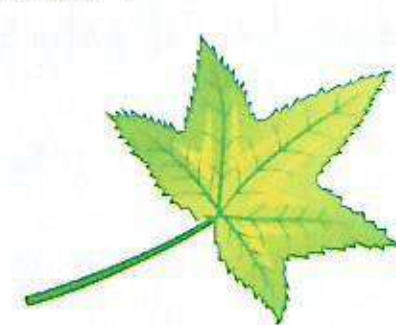
7 A woman gives birth to 4 children, each of them has different blood group from the other. So, the genotypes for the parents' blood groups are

- (a) (AB) and (AO).
- (b) (AB) and (OO).
- (c) (AB) and (BO).
- (d) (AO) and (BO).

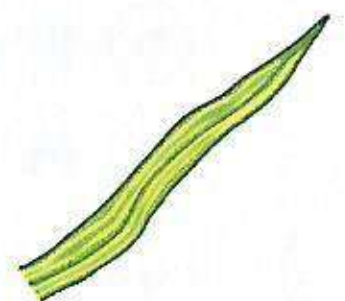
8 Study the two opposite figures no. (1) and (2), then answer :

Which of the following statements is correct ?

- (a) The roots of the plants of figure no. (1) are fibrous.
- (b) The vascular bundles of the plants of figure no. (2) are arranged in a ring in the stem.
- (c) Maize plant belongs to the plants of figure no. (1).
- (d) The flowers of the plants of figure no. (2) have trimerous floral whorls or their multiplies.



(1)



(2)

9 Which of the following genetic cases whose appearance depends on the presence of a dominant gene in human ?

- (a) Baldness.
- (b) Infantile dementia.
- (c) Colour blindness.
- (d) Haemophilia.

10 Which of the following living organisms contains radula ?



a



b




9



④

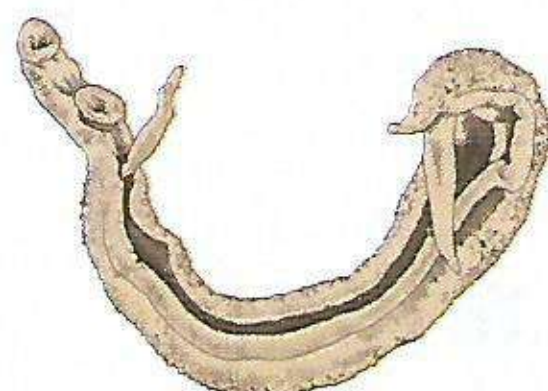
Answer the following questions (11 : 17) :

11 Explain : although *Euglena* contains chloroplasts, it is not classified among kingdom Plantae.

12  A woman has pure brown eyes and carrier to haemophilia disease gene married to a blue-eyed man suffering from haemophilia. **Show the children's genotypes** [knowing that the brown eyes gene (B) dominates over the blue eyes gene (b)].



- 13 The following figures show two types of living organisms, determine the similarities and the differences between them :



(1)



(2)

	Organism (1)	Organism (2)
Similarities :	<hr/> <hr/>	
Differences :	<hr/> <hr/>	<hr/> <hr/>

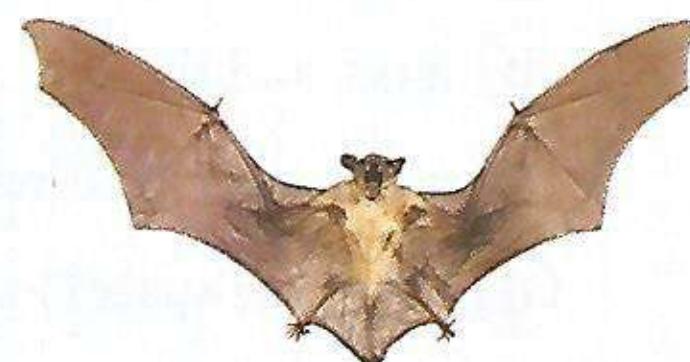
- 14 ✎ Design a bilateral dichotomous key for classifying the following living organisms :
(*Amoeba* - *Polysiphonia* - *Fucus* - *Spirogyra*)

Depending in the classification on the following characters, according to their arrangement :

- Mode of nutrition (autotrophic or heterotrophic).
- The presence of chloroplasts or chromatophores.
- Colour of chromatophores (brown or red).

- 15 What would you expect to happen in case of : the crossing of two corn plants, where both of them are hybrid green ? (Without genetic analysis).

- 16 The opposite figure shows a mammal, illustrate how it is adapted for flying process.



- 17 The opposite table shows the resulted generation from crossing two sweet pea plants :

♀ \ ♂	AB	(X)	(Y)	ab
W	....(1)....	AABb	....(2)....	....(3)....
L	....(4)....	AaBb	....(5)....	aaBb

- (a) Deduce the genotypes for parents and offspring.

- (b) What is the ratio of the resulted white flowers from crossing (2) and (4) plants ?



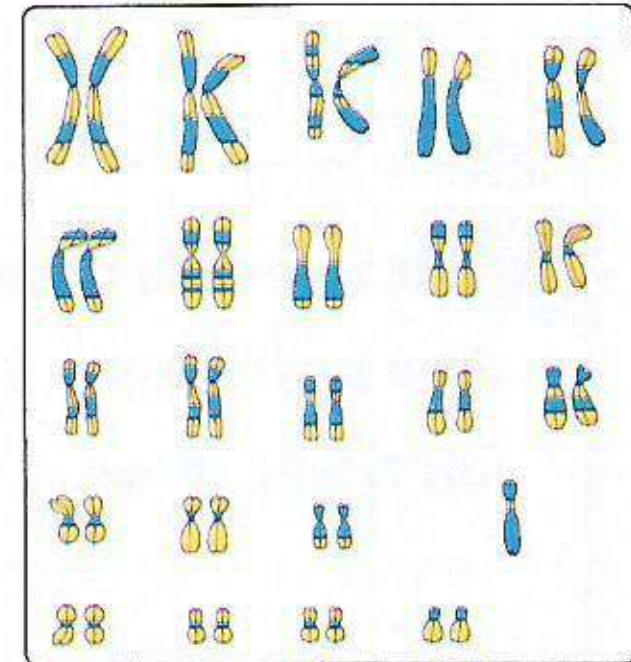
Model Exam

9

Choose the correct answer (1 : 10) :

1 The opposite figure shows the karyotype for a somatic cell of

- (a) a female suffering from polyploidy.
- (b) a normal female.
- (c) a female with Turner's syndrome.
- (d) a female with Down's syndrome.



2 In the taxonomic hierarchy, which of the following levels contains the largest number of living organisms ?

- (a) Family.
- (b) Species.
- (c) Order.
- (d) Genus.

3 If a white blood cell in a cat female contains 38 chromosomes, the number of chromosomes in its ovum equals

- (a) 18
- (b) 19
- (c) 38
- (d) 76

4 Which of the following organisms don't reproduce by spores ?

- (a) Ascomycetes.
- (b) Ferns.
- (c) Sporozoans.
- (d) Sponges.

5 When crossing two green pea plants carrying white flowers, the percentage of purple flowers in the resulted generation is

- (a) 100%
- (b) 75%
- (c) 25%
- (d) 0%

6 From the plants that forms the flowers is

- (a) *Pinus*.
- (b) *Polypodium*.
- (c) *Adiantum*.
- (d) lily.

7. The individual with genotype (AaBb) gives gametes, what is the percentage of the gametes carrying one dominant gene only ?
- (a) 100% (b) 75% (c) 50% (d) 25%
-
8. Which of the following living organisms whose cell wall contains silica substance ?
- (a) Archaeobacteria. (b) Eubacteria.
(c) Diatoms. (d) Mushroom.
-
9. The person whose blood cells don't contain antigens, his/her blood group is
- (a) AB⁺ (b) O⁻
(c) AB⁻ (d) O⁺
-
10. Rhinoceros and deer share in all the following, except
- (a) eating herbs.
(b) the presence of horny hooves for each toe.
(c) the number of toes.
(d) suckling their young.
-

Answer the following questions (11 : 17) :

11. In a certain strain of birds, the crossing occurs between a red-feathered male and a white-feathered female. So, the resulted generation was, as follows : white-feathered females, red-feathered females, white-feathered males and red-feathered males with the ratio 1 : 1 : 1 : 1. **Explain the genotypes of the parents and the individuals of the resulted generation** (knowing that the female in birds is the sex determinant).



- 12 Give reason for : each of *Nostoc* and *Euglena* is a unicellular autotrophic organism and classified into two different kingdoms.

- 13 How far this statement is correct, with explanation :
"All aquatic animals breathe by gills".

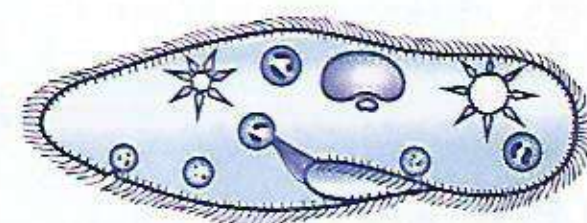
- 14 The opposite table shows the individuals of the resulted generation from crossing two strains of pea flower plant, in the light of that, deduce :

♀ \ ♂	AB	....(1)....	aB	ab
	AABB		AaBB	
aB		AaBb		

(a) The genotype of gamete no. (1).

(b) The percentage of the resulted white flowers from this crossing.

- 15 Identify the opposite living organism, then mention the class to which it belongs.



- 16 What happens in case of : the increase of numbers of Earthworms inside the soil ?

- 17 Someone wants to marry from her cousin, his friend advised him to perform a group of medical examinations before marriage. What is your opinion about his friend's advice ? Explain your answer.

Model Exam 10

Choose the correct answer (1 : 10) :

- 1 The ratio between the number of chromosomes in a somatic cell to their number in a gamete cell for the same organism is
- (a) 1 : 1 (b) 2 : 1
(c) 1 : 2 (d) 3 : 1
- 2 The arrangement of class in the taxonomic hierarchy of living organisms is
- (a) preceding the family and following the genus.
(b) preceding the species and following the phylum.
(c) preceding the order and following the phylum.
(d) preceding the kingdom and following the family.
- 3 The ratio of the second generation when crossing two pure individuals that differ in a pair of allelomorphic mendelian characters is
- (a) 3 : 1 (b) 1 : 2 : 1
(c) 9 : 7 (d) 9 : 3 : 3 : 1
- 4 All the following living organisms whose nucleus contains nuclear membrane, except
- (a) *Paramecium*. (b) diatoms.
(c) *Plasmodium*. (d) *Nostoc*.
- 5 When the chromosomal structure of a person is (44 + XY), it represents a
- (a) normal male.
(b) male with Down's syndrome.
(c) normal female.
(d) female with Down's syndrome.



6 From the marine weeds that consist of filaments adhering together by a gelatinous membrane is(are)

- a *Spirogyra*.
- b *Fucus*.
- c *Polysiphonia*.
- d diatoms.

7 If the blood group of the parents of father is (O), it is impossible that the grandchildren have the blood group

- a (A).
- b (B).
- c (O).
- d (AB).

8 From the animals whose body is characterized by radial symmetry and doesn't contain a head is

- a sea cucumber.
- b sea urchin.
- c *Aurelia*.
- d sea star.

9 All the following may inherit the colour blindness gene from a man who suffers from this disease, except

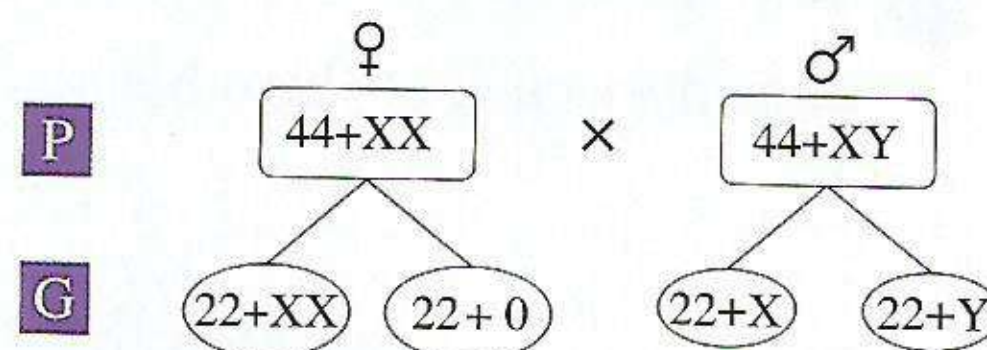
- a granddaughters.
- b grandsons.
- c daughters.
- d sons.

10 The higher vertebrates that live in water is(are)

- a *Lamprey* fish.
- b dolphins.
- c sharks.
- d ray fish.

Answer the following questions (11 : 17) :

- 11 The opposite figure shows the genetic analysis for abnormal chromosomal cases in human :



(a) Does the defect occur during the formation of the sperms or ova ?

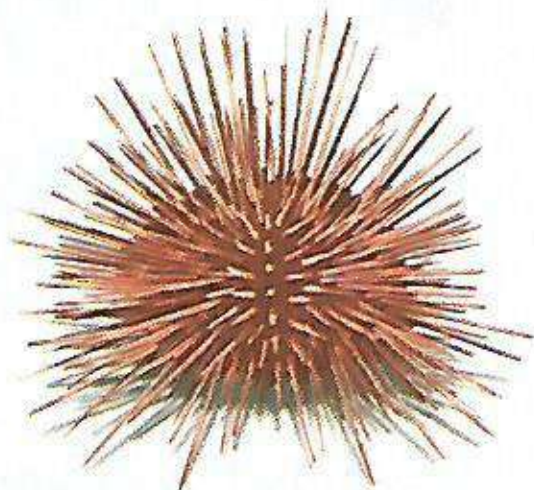
(b) What are the abnormal chromosomal cases resulted in the offspring ? And what is their chromosomal structure ?

- 12 If you have a sample of pond water and you can examine it by the light microscope. What are the expected micro-organisms found in the sample ? And to which kingdoms do they belong ?

- 13 "A man married to a woman and they gave birth to a son with infantile dementia, the son lived for several years, then passed away". Discuss the statement without genetic analysis.



- (14) The following figures represent two different species of living organisms. To which class does each of them belong ?



(1)



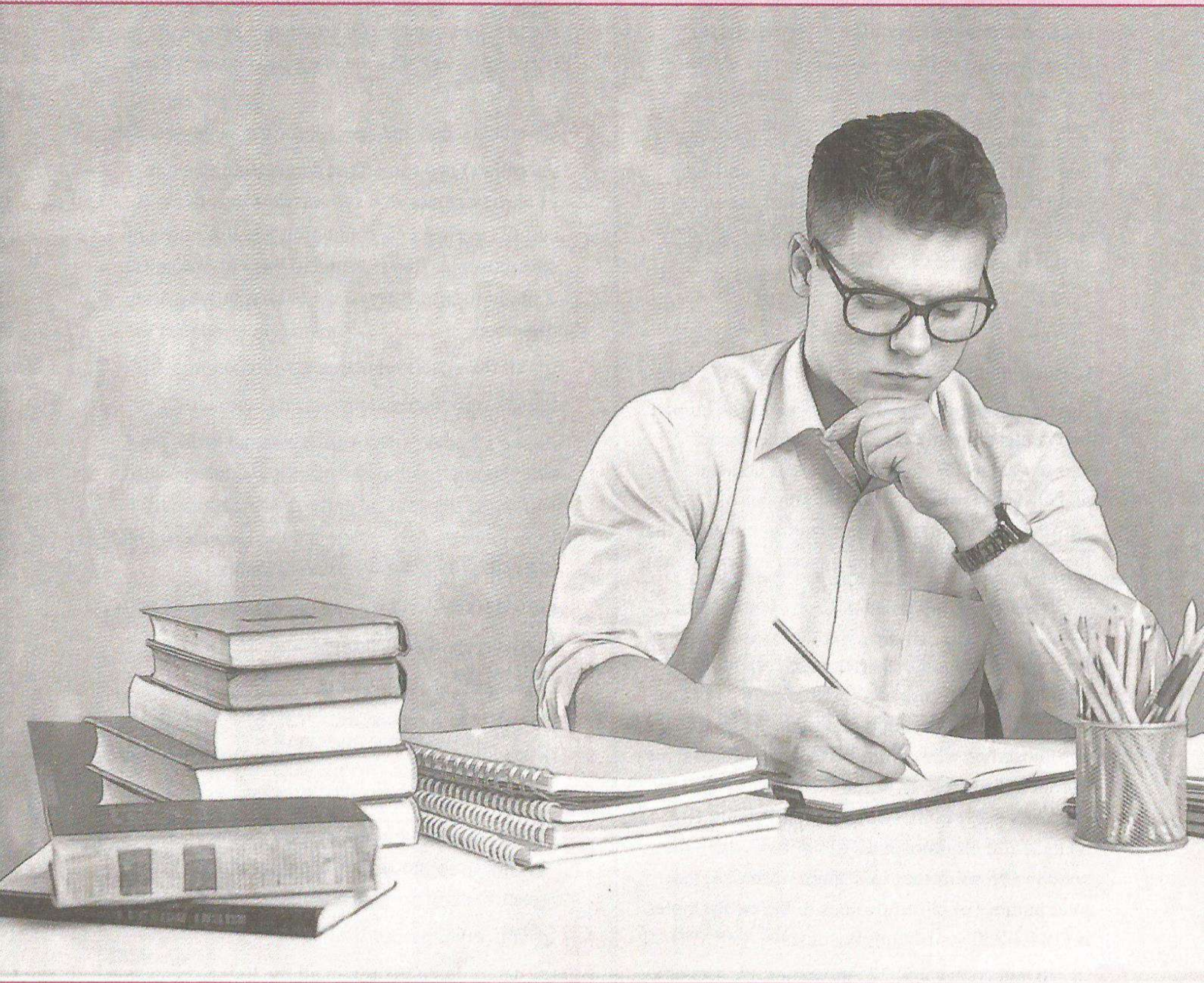
(2)

- (15) A man with blood group (O) and suffered from the colour blindness married to a healthy woman (pure) with blood group (AB). Illustrate the phenotypes and genotypes that are possible to appear among children.

- (16) Explain : dinoflagellates are not classified among class Flagellata.

- (17) What happens in case of : the absence of air sacs from the bodies of birds ?

Answers | of The Book Questions



Unit Three

Answers of Chapter One

Lesson 1

First Answers of Multiple Choice Questions

- 1 (d)
- 2 (d) The somatic traits of the living organism.
- 3 (c) the type of sex chromosomes.
- 4 (d) $2X + 2$

As the somatic chromosomes are found in the body cells in homologous pairs ($2X$), and each body cell contains a pair of sex chromosomes (i.e. the chromosomal structure of the body cells of this organism is $(2X + 2)$).

- 5 (a) 22
- 6 (d) (8)
- 7 (d) their number is identical in all the cell's types.

As the number of chromosomes in all the human body cells (somatic cells "46 chromosomes" and sex cells "23 chromosomes") is constant and also the return of the even number of chromosomes ($2n$) after fertilization indicates that the chromosomes carry the genetic information in human.

- 8 (c) 414

As the white blood cells (somatic cells) in the blood sample "figure (A)" are the only cells that contain nuclei carrying homologous pairs of chromosomes whose number is 184 chromosomes in four cells (46×4), while the sperms (sex chromosomes) in the seminal fluid "figure (B)" contain 230 chromosomes (23×10), where they contain chromosomes in a single form, i.e. the total number of chromosomes in the two samples is ($184 + 230 = 414$ chromosomes).

- 9 (d) 46 autosomes and 22 autosomes.

As the nucleus of the somatic cell in human contains 46 chromosomes (44 autosomes + 2 sex chromosomes), while the nucleus of the gamete cell contains 23 chromosomes (22 autosomes + 1 sex

chromosome), where each chromosome contains one molecule of DNA, therefore the nucleus of the somatic cell contains 46 DNA molecules, while the nucleus of the gamete cell contains 23 DNA molecules.

- 10 (a) 1 : 2

As the boy arm muscle cell is a somatic cell containing one sex chromosome (X) only in addition to the sex chromosome (Y), while the girl arm muscle cell contains a pair of sex chromosomes (XX), i.e. the ratio between them is 1 : 2

- 11 (b) somatic cell and sex cell for the same organism

As cell (1) is a somatic cell containing 3 pairs of chromosomes in a symmetric form, while cell (2) is a sex cell containing a half number of chromosomes that is found in the somatic cell in a single form, i.e. two cells belong to the same organism.

- 12 (d) all the genetic characters will change.

- 13 (a) (X) only.

As the amount of DNA is duplicated when the cell is ready for division, while it decreases into half when the gonads' cells divide meiotically to form gametes (sex cells), and the amount of DNA remains as it is in case of no division.

- 14 (1) (d) 100% (2) (a) all the male somatic cells.

- 15 (c) the type of sex chromosome.

- 16 (d) the pair of sex chromosomes.

- 17 (1) (d) 22 chromosomes. (2) (b) 4 (3) (b) 14

- 18 (a) 21

- 19 (a) Somatic cell in a male.

- 20 (b) the number of genes carried on the chromosomes differs according to the type of the living organism.

- 21 (d) it is asymmetric.

- 22 (a) determining the sex in all the living organisms.
, (e) being always present at the end of the karyotype.

- 23 (b) diploid

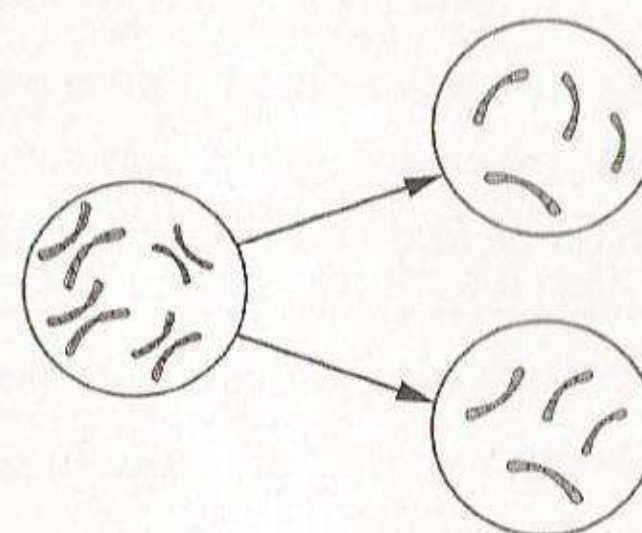
- 24 (c) (22).
 25 (c) (23).
 26 (b) it produces two types of gametes. ,
 (c) all chromosomes are found in homologous pairs.
 27 (a) meiotic division and fertilization
 As process (1) produces sex cells (gametes) that are formed from the meiotic division of gonads cells, where they contain haploid chromosomes (i.e. the half number of chromosomes that is found in the original cell), then the gametes fuse together to return the even number of chromosomes after fertilization.
 28 (b) meiosis, fertilization then mitosis
 29 (d) a cell (2n) is divided meiotically.
 30 (c)
 As the chromosome consists of the nucleic acid (DNA) and protein, where DNA molecule carries the genes that are responsible for the genetic traits of the living organism.
 31 (b) gene. , (d) protein.
 32 (a) They represent the male gametes in the plant.
 , (c) They contain the same number of chromosomes that are present in the ovule of the plant.

Second Answers of Miscellaneous Questions

1

	Karyotype (1)	Karyotype (2)
Similarities :	<ul style="list-style-type: none"> Both of them : <ul style="list-style-type: none"> Represent somatic cells. Contain two sets of homologous pairs of chromosomes. 	
Differences :	<ul style="list-style-type: none"> Represents a somatic cell of a male of <i>Drosophila</i> insect. The sex chromosomes are asymmetric (heterozygous). 	<ul style="list-style-type: none"> Represents a somatic cell of a female of <i>Drosophila</i> insect. The sex chromosomes are symmetric (homozygous).

- 2 The statement is wrong / Because the meiotic division of gonad's cells of human male gives two different types of sperms, where one of them carries the sex chromosome (X) and the other carries the sex chromosome (Y).
 3 • **The principle :** sex cells (gametes) contain half the chromosomes number (n) that is present in the somatic cells, due to the meiotic division of gonads' cells, where the homologous pairs of chromosomes are segregated into two equal sets of chromosomes and assorted into gametes.
 • **The wrong :** the segregation of homologous pairs of chromosomes (4 pairs) into two unequal sets in the gametes, where one of them contains 5 chromosomes and the other contains 3 chromosomes.
 • **The correction :**



- 4 The statement is wrong / Because the human female cells don't contain the sex chromosome (Y) and they perform all their biological functions in a normal way. So, the sex chromosome (Y) isn't necessary for the human life.
 5 (a) • Cell (Y) : sperm cell.
 • It contains 22 autosomes, because it is a sex cell (gamete) formed as a result of the meiotic division of gonads' cells (2n) that contain 44 autosomes and a pair of sex chromosomes, giving the sperm (n) which contains 22 autosomes and 1 sex chromosome.
 (b) (44 + XY).
 6 • The homologous pairs of chromosomes in gonads' cells (somatic cells) are segregated into two equal sets of chromosomes and assorted among gametes.

- Each pair of chromosomes behaves independently during its transmission in the gametes.
- During fertilization "the fusion of the male gamete (n) with the female gamete (n) to form the zygote (2n)", the diploid number of chromosomes returns back again (2n).

7 Because the somatic cell contains two sets of homologous chromosomes arranged in pairs (one of them is inherited from the father and the other is inherited from the mother). So, it is diploid cell (2n). While the gamete contains one set of single chromosomes, which means that it contains half the chromosomes number that is found in the somatic cell. So, it is haploid cell (n).

8 The statement is wrong / Because the gametes (sex cells) are formed mainly by meiotic division of gonads' cells, where the homologous pairs of chromosomes are segregated into two equal sets of chromosomes and assorted into gametes.

- 9** (a) • **Karyotype (1)** : somatic cell, because the chromosomes are found in homologous pairs (23 pairs).
- **Karyotype (2)** : sex cell, because the chromosomes are found individually (23 chromosomes).
- (b) A female karyotype, because the sex chromosomes pair no. (23) is symmetric (XX).
- (c)

	Karyotype no. (1)	Karyotype no. (2)
No. of autosomes	44 (22 pairs)	22
No. of sex chromosomes	2 (one pair)	1

Lesson 2

First Answers of Multiple Choice Questions

- 1** (c) the character is controlled by a pair of genetic factors.
- 2** (b) Tt / t / Tt

3 (d) 150

4 (b) (RR) and (Rr).

5 (b) the gene of the character in insect (A) dominates over the gene of the character in insect (B).

6 (a) 25%

7 (c) (Aa) × (aa).

8 (b) 75%

9 (a) the dominant character is appeared with two genotypes.

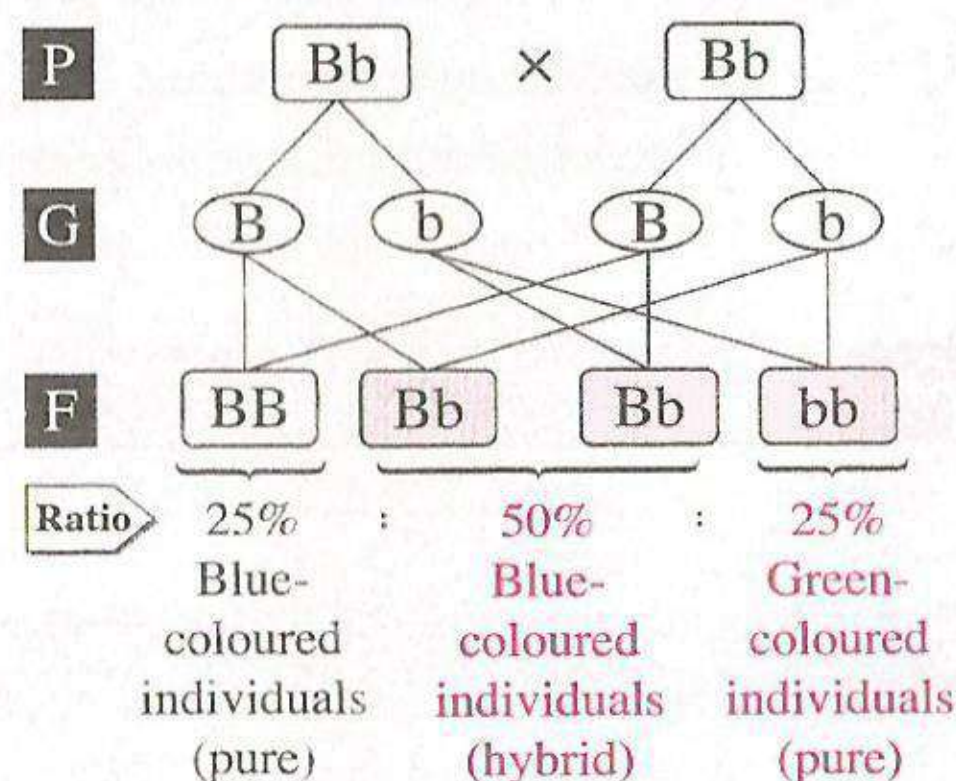
(e) the allelomorphic characters are expressed by two phenotypes.

10 (a) 100% purple flowers.

11 (c) bb / Bb

As when a crossing between blue-coloured male and female takes place, blue and green-coloured individuals are produced.

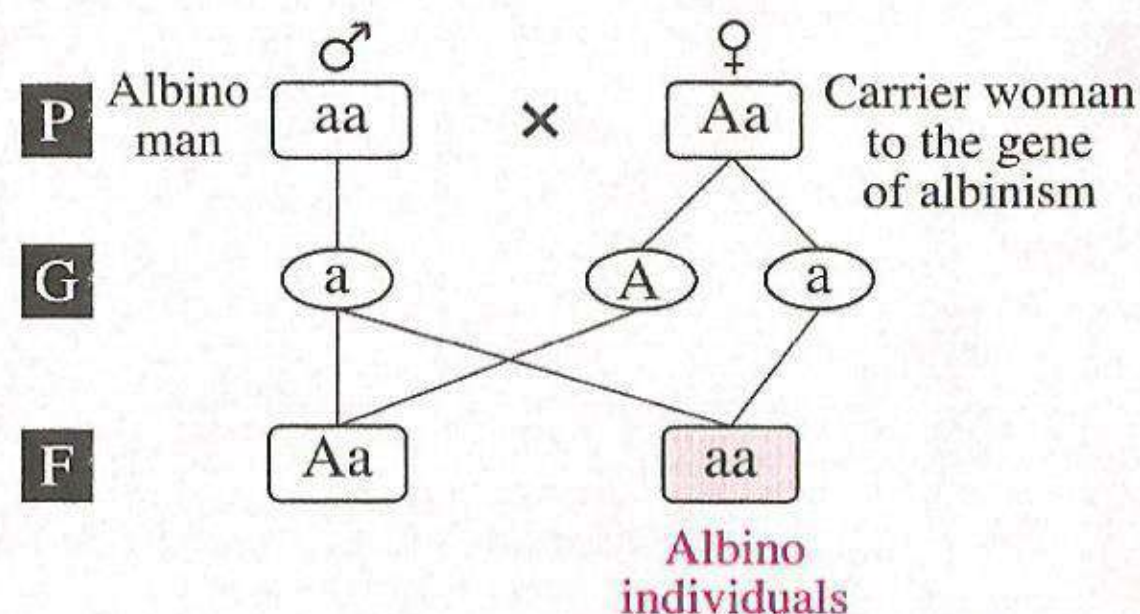
∴ The crossing occurred between hybrid blue-coloured individuals, as follows :



∴ (B) represents blue-coloured individuals (50%) carrying the genotype Bb, while (A) represents green-coloured individuals (25%) carrying the genotype bb

12 (b) 50%

As the crossing of an albino man (carrying a recessive character) (aa) with a carrier woman (hybrid dominant) (Aa) produces 50% of offspring carrying the albinism character "recessive", 50% of offspring carrying the albinism gene "hybrid dominant", as follows :



\therefore The possibility of the appearance of this character in the offspring is 50%

13 (c) 50%

14 (1) (a) Ee

\therefore The father of this woman suffers from the upper eyelid relaxant "i.e. carrying the gene of the eyelid relaxant" and her mother is normal "i.e. pure recessive and doesn't carry the gene of the character".

\therefore The genotype of this woman is hybrid dominant (Ee).

(2) (d) (a) or (b).

\therefore The genotype of the woman is hybrid dominant (Ee) and her mother is normal (ee).

\therefore The genotype of the woman's father is pure dominant (EE) or hybrid dominant (Ee).

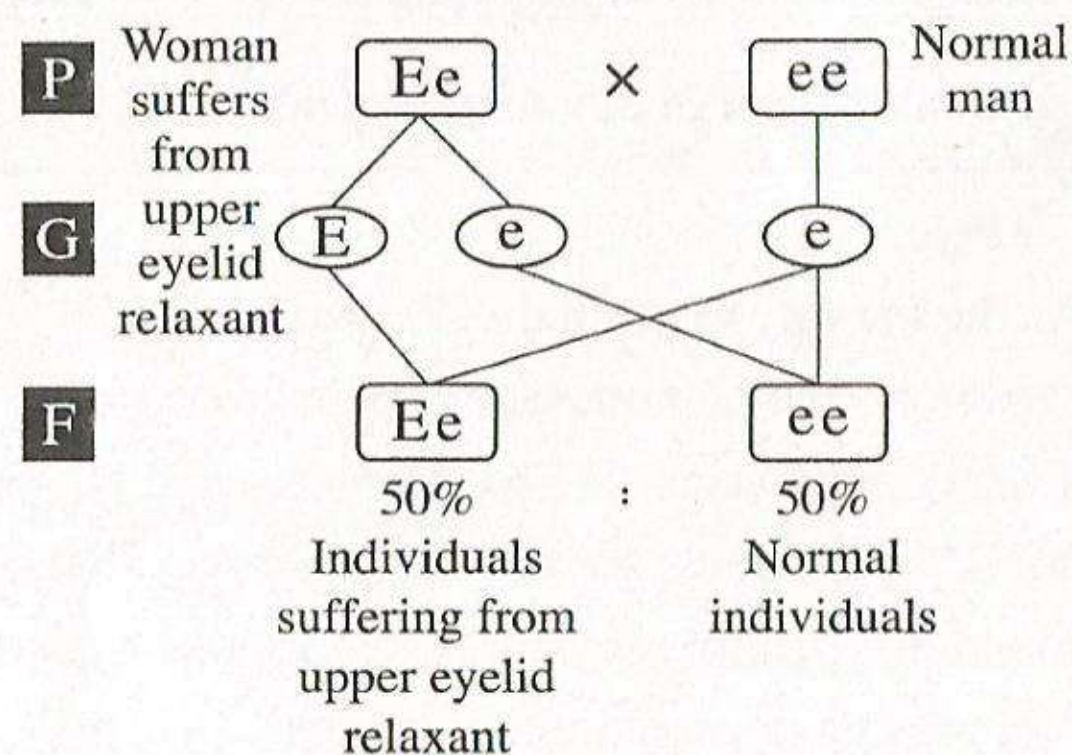
(3) (c) ee

\therefore The mother of this woman is normal.

\therefore Her genotype is (ee).

(4) (c) 50%

When this woman "hybrid dominant (Ee)" is married to a normal man "recessive (ee)", therefore 50% of offspring carries the upper eyelid relaxant character (hybrid dominant) with genotype (Ee), 50% of offspring is normal with genotype (ee), as follows :



15 (d) $Aa \times Aa$

16 (1) (d) 25%

(2) (a) $GG \times Gg$

17 (c) $aabb$

18 (b) 50%

19 (d) $aabb$

20 (b) 50% (gH).

21 (c) 50%

22 (d) four

23 (c) one dominant gene.

24 (1) (a) $YySs$

(2) (b) 25%

When a crossing takes place among the first generation individuals ($YySs$). So, the percentage of individuals that carry the same phenotypes and genotypes of the parents ($YySs$) = $\frac{4}{16} \times 100 = 25\%$

25 (1) (a) the number of alleles for each genetic trait.

(2) (b) the similarity of phenotypes.

26 (d) $BbXY$

(e) $bbXX$

27 (c) $Aa \times Aa$

(d) $AA \times Aa$

Second Answers of Miscellaneous Questions

1 As when crossing two pure individuals of pea plant that differ in the flowers colour character, where one of them carries purple-coloured flowers (RR) and the other carries white-coloured flowers (rr), all the individuals of the first generation carry purple flowers (Rr) with 100%. This is because the purple colour gene (R) dominates completely over the white colour gene (r). So, the appearance of white colour needs the convergence of the recessive character genes (rr) together, according to Mendel's first law.

2 (a) This means that this case is a complete dominance case, and the character appeared in the offspring of the first generation is the dominant character that is carried by one parent in a pure form, according to Mendel's first law.

(b) This means that flowers with axillary site gene dominates over flowers with terminal site gene, as on crossing two plants with axial flowers, the resulted generation will be with a ratio 3 (with axillary site) : 1 (with terminal site), according to Mendel's first law.

- 3 • As the appearance of a new character in the resulted individuals means that the parents carry the genes of long wings character in a hybrid dominant form. So, the individuals of the second generation will carry the dominant and recessive characters (long and short wings) with a ratio 6 : 2, "i.e 3 : 1" respectively.

- The percentage of short wings character in the resulted generation is 25%

- 4 (a) • The genotype of individuals (1) and (2) is : (Rr).

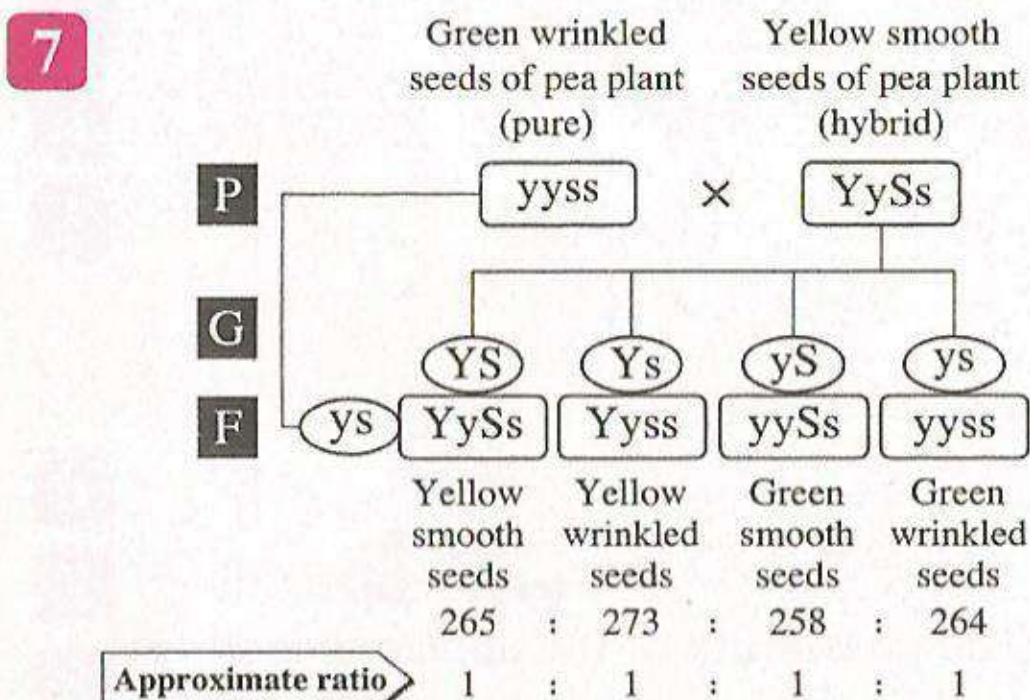
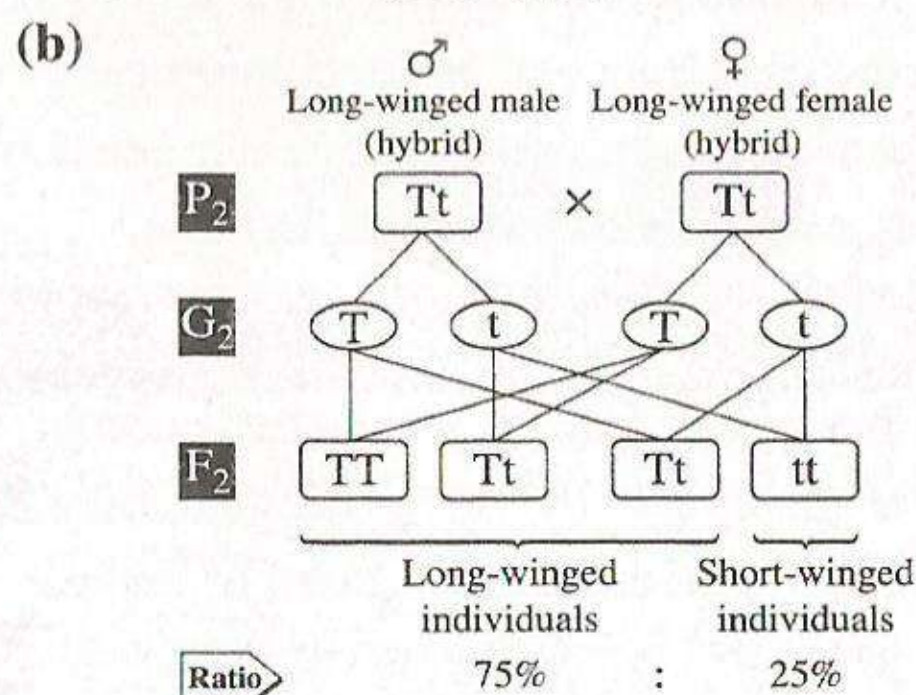
- The phenotype of individuals (1) and (2) : both of them have purple-coloured flowers.

- (b) • The pure genotypes are (RR) and (rr).

- Their percentage is 50% from the resulted generation.

- 5 **The statement is wrong** / Because in case of complete dominance, when a pair of allelomorphic characters (pure) is inherited, the individuals of the second generation carry the two characters (dominant and recessive) with a ratio 3 : 1 respectively. So, the percentage of the dominant character in the second generation is 75%

- 6 (a) Genotypes for the parents of the second generation : (Tt), (Tt)



- 8 (a) (1) Bm

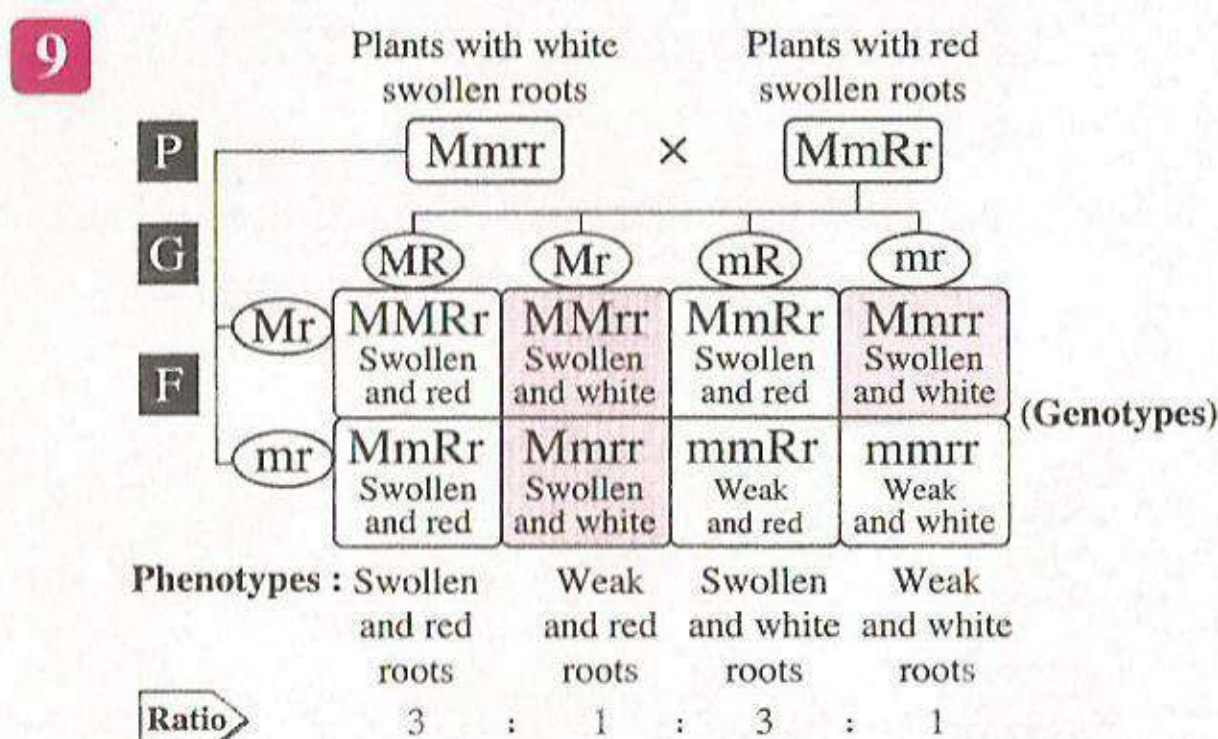
- (2) bm

- (b) • The phenotype of the individual no. (3) : Brown long-horned.

- The phenotype of the individual (5) : White short-horned.

- (c) • The genotype of individual no. (4) : bbMm

- The phenotype of individual no. (4) : White long-horned.



∴ The percentage of plants with white swollen roots is 37.5% ($\frac{3}{8}$).

Answers of Model Exam on Chapter 1

- 1 (d) stomach cell of a human female.

- 2 (c) Figure (3).

As the karyotype in figure (3) contains 46 chromosomes in homologous pairs arranged descendingly according to their sizes and the pair no. (23) represents the sex chromosomes that are found in a symmetric pair (XX). So, this figure represents a normal human female.

3 (b) Figure (2).

As figure (2) in which the chromosomes pairs no. (9) and no. (20) are found in an asymmetric form (heterozygous pairs).

4 (a) figure (1).

5 (b) $(2n) \rightarrow (2n) \rightarrow (n) \rightarrow (2n)$

As the first cell is diploid ($2n$) divides mitotically to give a diploid cell ($2n$) which divides meiotically to give a haploid cell (n), and on fertilization the even number of chromosomes returns back again ($2n$).

6 (a) 25%

7 (c) $X - 2$

As the number of chromosomes (X) in the skin cell (somatic cell) is considered the number of autosomes + the number of sex chromosomes. So, the number of somatic chromosomes in a stomach cell = $(X - 2)$.

8 (b) a sequence of nucleotides.

9 (b) 50%

10 (b) aaBb

11

	The sperm in human	The ovum in human
Similarities :	<ul style="list-style-type: none"> • They represent sex cells (gametes) having one set of chromosomes which is half the number of chromosomes found in the somatic cells in the form of single chromosomes (i.e. they are haploid cells (n)). • They are produced from the meiotic division of gonads' cells (male and female). 	
Differences :	<ul style="list-style-type: none"> • It is the human male gamete. • It is found in testis. 	<ul style="list-style-type: none"> • It is the human female gamete. • It is found in ovary.

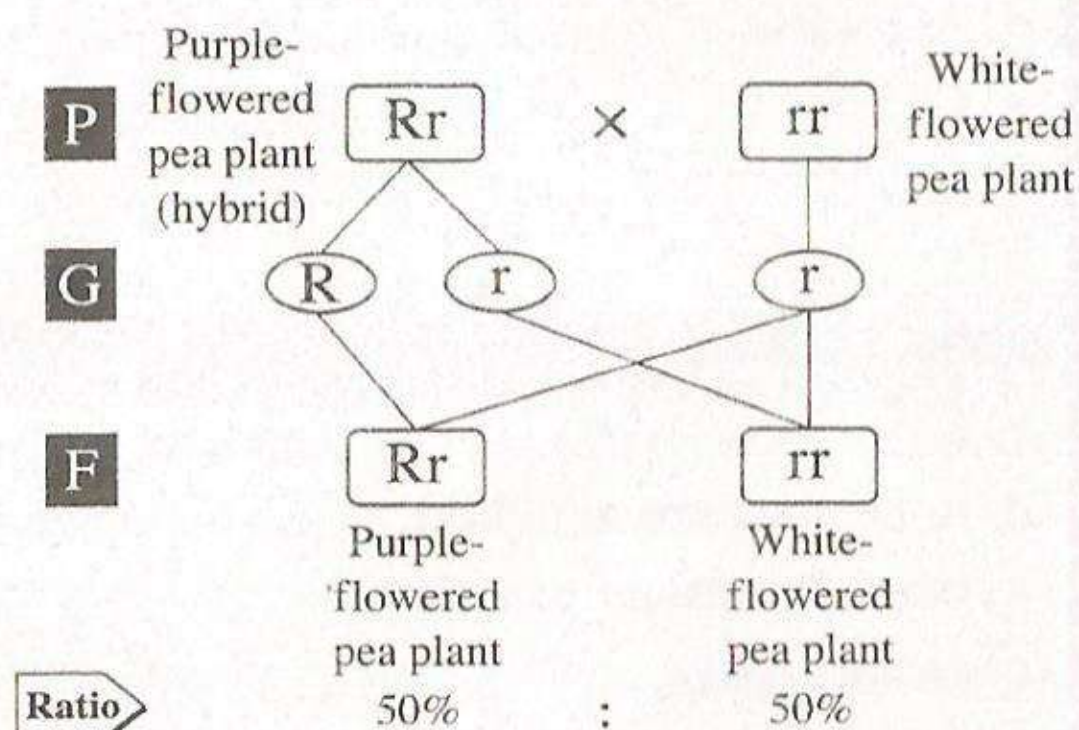
12

♀ \ ♂	AB	Ab
aB	AaBB	AaBb
ab	AaBb	Aabb

13 The statement is wrong / As the recessive genetic trait doesn't appear, except on the convergence of the recessive genes together as in Mendel's laws. So, the recessive character doesn't appear among the first generation individuals, but it appears in the second generation.

14 The new gametes are formed with full genetic information ($2n$), have the same genetic information of the parent cell and have the same function, where on the fusion of the contents of two parent cells, the number of chromosomes will duplicate in the resulted individual. So, the duplication of the chromosomes number will occur in every generation.

15



∴ The percentage of purple-flowered plants is 50%

16 (a) Male, because the sex chromosomes (pair no. (19)) are found in asymmetric pair (XY), where one of them is short and the other is long.

(b) Somatic cell, because the chromosomes are found in pairs (19 pairs "38 chromosomes").

17 The resulted flowers are white-coloured.

Answers of Chapter Two

Lesson 1

First Answers of Multiple Choice Questions

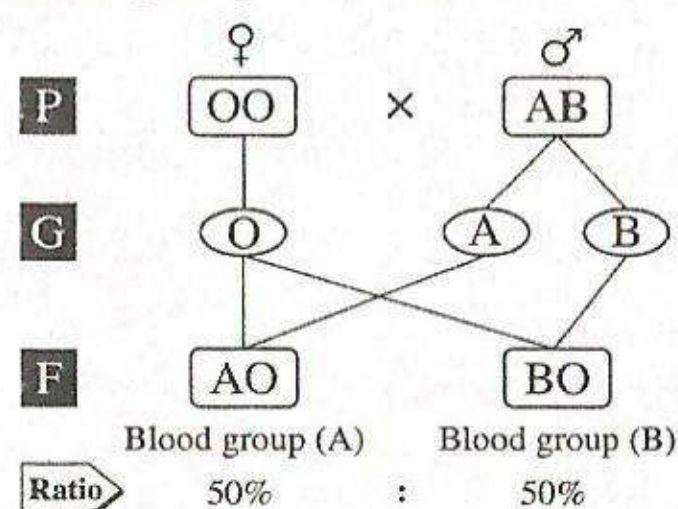
- 1 (d) (4) only.
- 2 (a) the appearance of the two genes effect together.
- 3 (c) representing the character by a pair of genes.
- 4 (1) (c) 50% (2) (d) 25%
- 5 (a) purple-coloured flowers trait in pea plant.
- 6 (d) 0%
- 7 (1) (c) (RL) and (RL).
(2) (a) 1 (3) (d) 0%
- 8 (c) The phenotypes of offspring E, F and G are the same.
- 9 (a) 25%
- 10 (b)
- 11 (a) the gene (A) doesn't dominate over the gene (B).
(d) the genes (A) and (B) participate together to appear this blood group.
- 12 (b) (B).
- 13 (d) AO × BO
- 14 (d) O
- 15 (a) A
- 16 (c) 5
- 17 (c) 0% (AB) and 0% (O).
- 18 (b) L
- 19 (d) it may be pure or hybrid.
- 20 (c) white flowers of pea plant.
- 21 (c) (A) or (AB).
- 22 (d) 0%

∴ The blood group of the man carries antigens (A) and (B).

∴ His blood group is (AB).

∴ The mother's blood group doesn't carry antigens (A) and (B).

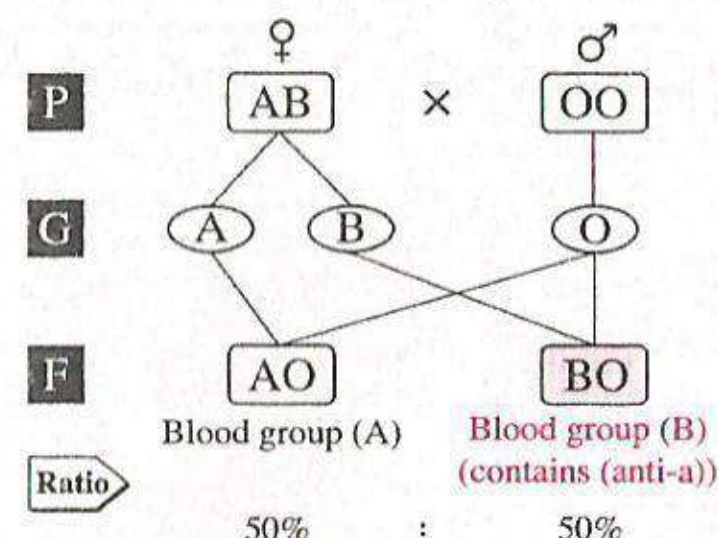
∴ Her blood group is (OO).



∴ The percentage of children having blood group (AB) is 0%

- 23 (b) 50%
- 24 (d) BO / AO
- 25 (d) (AO) and (BO).
- 26 (c) (AB) and (B).
- 27 (d) (O).
- 28 (a) contain antigens (A).
(d) agglutinate when adding (anti-a).
- 29 (c) BO
- 30 (d) Father with a universal donor blood group and a mother has blood group containing antigens (A) and (B).

As the crossing through which the individuals with blood groups having antibodies (anti-a) are produced is that when crossing between the father whose blood group is a universal donor (O) and the mother whose blood group contains antigens (A) and (B), (i.e. the blood group is (AB)) occurs.



- 31 (a) AO
- 32 (a) AA, (c) BB
- 33 (d) (BB).
- 34 (d) (AB).
- 35 (b) AO, (e) BO
- 36 (d) (ABRh⁺).

As the person with blood group (ABRh⁺) whose blood contains antigens (A) and (B), in addition to Rhesus factor antigens, (i.e. his blood contains three types of antigens).

- 37 (c) 45
- 38 (c) OORh⁻Rh⁻

As the person with blood group (OORh⁻Rh⁻) whose blood doesn't contain any antigens, where his blood group (O) is free from antigens (A) and (B) and also free from Rhesus factor antigens.

- 39 (1) (C) AB / B
 (2) (a) some antibodies.
 (3) (d) the reaction occurred with (anti-a).

40 (b) 1

41 (C) 2

As the blood group (B⁺) contains antigen (B), in addition to Rhesus factor antigens.

42 (a) 0%

As Rhesus factor of the baby is symmetric with the Rhesus factor of the mother (Rh⁻Rh⁻), therefore the production of antibodies in mother's blood for the antigens which specialized for Rhesus factor doesn't take place, leading to no death of the second baby, even if the Rhesus factor of the 2nd baby is positive (Rh⁺).

43 (a) (A)

Second Answers of Miscellaneous Questions

- 1 (a) Lack of dominance case / As the generation resulted from this crossing contains three individuals phenotypes and the mendelian ratio changes from 3 : 1 to 1 red-feathered bird : 2 orange-feathered birds : 1 yellow-feathered bird (86 : 161 : 93) respectively.
 (b) As when crossing orange-feathered sparrows (RY), the genes of the red colour character gather together (RR) in the resulted generation. So, the red colour appears. Also, the yellow colour character genes gather together (YY) in the resulted generation. So, the yellow colour appears and they represent new characters that differ from the parents.

- 2 The statement is wrong / As in case of lack of dominance, there are non-mendelian characters that aren't inherited according to Mendel's laws, as in the mating of two pure individuals that differ in a pair of genetic traits, the ratio of the second generation is 1 : 2 : 1, due to the appearance of a new character during the gathering of parents' traits, such as the inheritance of flowers colour in *Antirrhinum* plant and the inheritance of feather's colour in Andalusian chicken race.

- 3 Some symptoms appear on the receiver such as : body shiver, headache, chest pains, breathlessness, blueness, tachycardia with hypotension and these symptoms often end with death, this happens because the blood group (AB) (donor) contains antigens (B) and the blood group (A) (receiver) contains (anti-b). So, the agglutination happens in the receiver's blood.

- 4 Due to the presence of antibodies (anti-a) and (anti-b) in the person's blood. So, when he/she receives blood with any blood group which has antigens (A) or (B) or both of them, the agglutination happens immediately and leads to death. So, the blood must be transfused from the same blood group (O).

- 5 (a) 1. (3) blood group (AB).
 2. (2) blood group (A) and (1) blood group (O).
 3. (1) blood group (O).
 (b) The father, because his blood group is (O) (universal donor) donates blood to all blood groups, due to the absence of antigens (A) and (B).

6

Blood group (AB)	Blood group (O)
<ul style="list-style-type: none"> Represents a lack of dominance case. Its genotype is (AB). Contains both types of antigens (A) and (B). Doesn't contain antibodies. It is a universal receiver. 	<ul style="list-style-type: none"> Represents a complete dominance case (recessive character). Its genotype is (OO). Doesn't contain antigens (A) or (B). Contains both types of antibodies (anti-a and anti-b). It is a universal donor.

- 7 We can identify the unknown blood group through :
 • Separating the blood plasma (by using the centrifuge) of the blood group (A) "first tube" which contains antibodies (anti-b) and also for the blood group (B) "second tube" which contains antibodies (anti-a).

- Placing two drops of blood from the third tube (unknown) separately at the two ends of a clean glass slide, then add a drop of plasma from blood group (A) and blood group (B) on each drop of the unknown blood.
- Mixing each of them separately.

So, we have the following possibilities for the third tube :

1 st blood drop + (anti-a) "second tube"	2 nd blood drop + (anti-b) "first tube"	The possible blood group
Agglutination (+)	No agglutination (-)	A
No agglutination (-)	Agglutination (+)	B
Agglutination (+)	Agglutination (+)	AB
No agglutination (-)	No agglutination (-)	O

- 8** Because the blood group (AB) receives blood from all the blood groups, due to the absence of the two types of antibodies (anti-a) and (anti-b). So, it is a universal receiver.

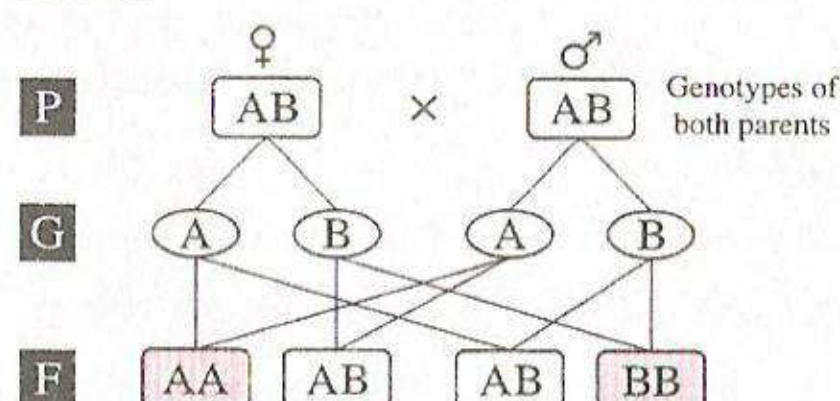
- 9** (a) Blood group no. (3) (AB).

(b) Blood group no. (4) (O).

(c) No. (1) is blood group (A) and no. (4) is blood group (O), because the blood groups (A) and (O) contain antibodies (anti-b) and the receiver blood group contains antigen (A). So, no agglutination happens during blood transfusion.

- 10** ∴ The blood groups of the two sons are different and the blood of both of them can be transfused to the parents that have the same blood group.

∴ The genotypes of the parents blood group must be (AB), because this group is a universal receiver.

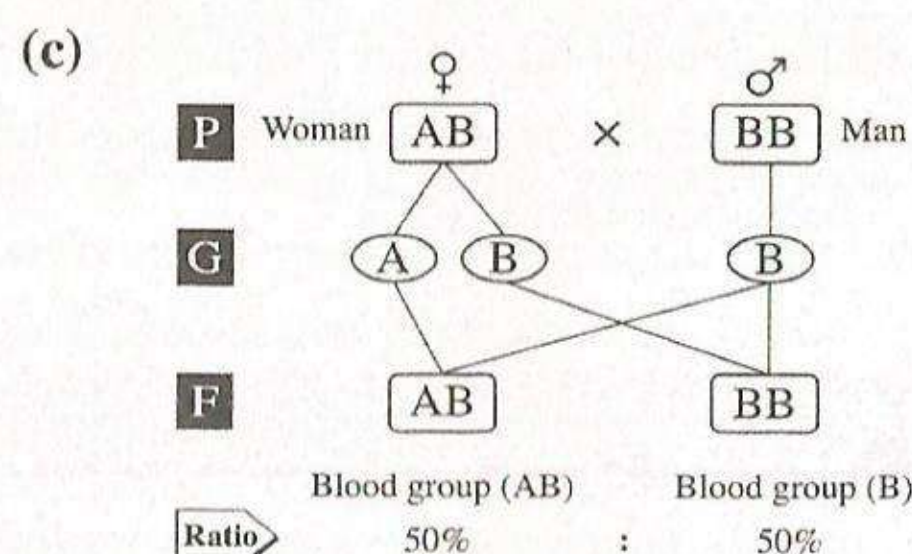


∴ The genotypes of the two sons blood group are : (AA) and (BB).

- 11** Because the blood group (A) contains antigens (A) and the blood group (B) contains antibodies (anti-a) against this type of antigens. So, when blood transfused from the group (A) to the group (B), an agglutination takes place immediately, as some symptoms appear on the receiver person, such as : body shiver, headache, chest pains, breathlessness, blueness, tachycardia with hypotension and these symptoms often end with death.

- 12** (a) (AA) or (AO).

(b) Blood group (B).



∴ The percentage of children having blood groups different from the parents is 0%

- 13** Due to the presence of two types of antigens (A) and (B), as the type of the blood group is determined through the interaction between antigens and antibodies which are (anti-a) and (anti-b).

- 14** Due to the mismatching of the two blood groups in some chemical substances found on the RBCs' surface of the donor's blood as (Rh) antigens or the presence of antibodies against (Rh) in his blood plasma.

- 15** • The similar components in the two blood groups (B⁻) and (AB⁻) are :

- Antigen (B) on their RBCs.
- (Rh⁻) which means that their RBCs have no (Rh) antigens.

- The different components between the two blood groups (B⁻) and (AB⁻) :

The presence of antigen (A) on the RBCs' surface of the person with blood group (AB⁻), but it isn't found in the person with blood group (B⁻).

16 The mother has negative Rhesus factor (Rh^-).

17 To avoid the risks that are arisen from the formation of antibodies against the Rhesus factor antigens, causing the breakdown of red blood cells, due to the transfusion of (Rh^+) blood to a person with (Rh^-) factor.

18 This may be happened :

- If the first baby was (Rh^-), no antibodies would be formed in the mother's blood, due to the absence of (Rh) antigens on the RBCs' surface of the fetus. So, the second baby would not die, even if he was (Rh^+).
- If the second baby was (Rh^-), whereas the first baby was (Rh^+), no harm would occur to the 2nd baby, due to the absence of (Rh) antigens on the RBCs' surface for the 2nd baby that interact with antibodies found in the mother's blood.

Lesson 2

First Answers of Multiple Choice Questions

1 (b) AaBb

2 (c) 20

3 (b) 25%

4 (c) Aabb × AaBb

As the result of crossing between parents (AaBb) and (Aabb) is $\frac{3}{8}$ pink-flowered plants and $\frac{5}{8}$ white-flowered plants, as follows :

♂ \ ♀	AB	Ab	aB	ab
Ab	AABb Pink	AAbb White	AaBb Pink	Aabb White
ab	AaBb Pink	Aabb White	aaBb White	aabb White

5 (a) 50% aaBB : 50% AaBB

6 (b) AaBb × aabb

7 (d) inheritance of the character is controlled by a pair of genes.

8 (b) AaBb

9 (a) 25%

10 (a) inheritance of the character which is controlled by two pairs of genes.

11 (a) AAbb × aaBb ,

(c) aaBB × Aabb

12 (d) 8

13 (a) have two different phenotypes.

14 (a) 3

15 (d) 0%

16 (b) 9

As when a crossing occurs between two hybrid yellow-coloured fur mice, 18 yellow mice (hybrid dominant) and 9 grey mice (recessive) were produced, i.e. the ratio is 2 : 1 respectively. So, it is expected that the number of dead mice in uterus is about $\frac{1}{4}$ of the resulted offspring (i.e. 9 yellow mice "pure").

17 (d) 8

18 (d) the percentage of the dead offspring.

19 (d) recessive lethal genes.

20 (b) 2 : 1

21 (1) (b) 25%

(2) (c) $\frac{1}{16}$

The ratio of the first calf to be without legs is $\frac{1}{4}$ and also that of the second calf to be without legs is $\frac{1}{4}$. So, the ratio of the birth of two calfs without legs from these parents is $\frac{1}{4} \times \frac{1}{4} = \frac{1}{16}$

22 (c) flowers colour in green pea plant. ,

(e) shape of green pea plant seeds.

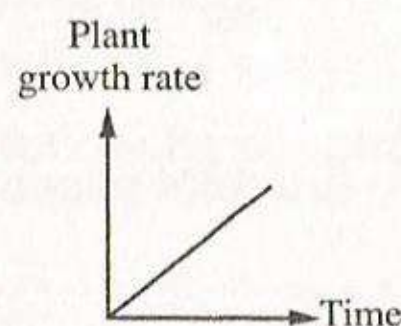
23 (d) D

As the gene that is responsible for the formation of root system in plant expresses itself efficiently in case of increasing the soil moisture. Therefore, it is preferred to irrigate the seedlings of the plant (D) by immersion.

24 (1) (d) D

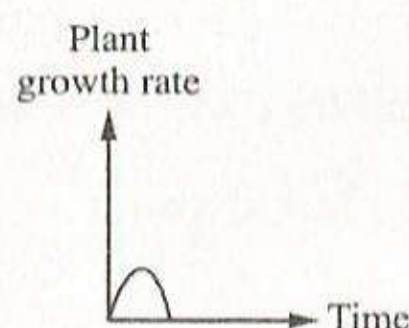
As the corn plant with genotype (Cc) is a green plant whose cells contain chlorophyll pigment that is responsible for the light energy

absorption to accomplish the photosynthesis process, leading to the increase in the rate of the plant growth through time, i.e. the relationship is directly proportional.



(2) (a) A

As the corn plant with genotype (cc) is free from chlorophyll pigment that acquires the plant its green colour and also is responsible for the absorption of light energy to accomplish the photosynthesis process. So, the white-coloured seedlings are formed, then wilt and die quickly after a short period of time.



25 (d) The fourth leaf.

As the most green leaf of the cabbage plant is the external leaf which is the greatest in size and characterized by being green in colour, because it is exposed continuously to the light to help in the formation of chlorophyll pigment.

26 (b) the nutrition has an important role in growing the mental competency.

27 (b) The protein components of protoplasm become damaged at 50°C.

(d) The highest rate of the growth genes activity is at 30°C.

28 (b) The green colour gene is affected by the environmental factors.

29 (a) $CC \times CC$,

(e) $CC \times Cc$

Second Answers of Miscellaneous Questions

1 (a) The parents' genotypes are : $AAbb \times aaBB$

(b) The first generation individuals have a new character (pink colour) that differs from the parents' character (white colour), because this case represents a complementary genes case, where the inheritance of a character is controlled by two pairs of genes and the dominant character appearance depends on the presence of a dominant gene at least from each pair, while the absence of any pair of dominant genes or both of them will lead to the absence of the dominant character and the appearance of the compatible character (recessive). So, the first generation appears with the dominant character (pink colour).

2 The statement is correct / Because this happens in the complementary genes case as in pea flower plant at which the dominant character (pink colour) appearance depends on gathering a dominant gene or more from each pair.

3 (a) (1) $AABB$ (2) $AaBB$ (3) $AABb$ (4) $AaBb$

(b) Both parents carry pink-coloured flowers.

(c) 25%

(d) 75%

4 The statement is correct / As the second generation in complementary genes case which is resulted from crossing two individuals carrying the dominant character (pink colour) with the genotype ($AaBb$) are pink-flowered plants and white-flowered plants with a ratio 9 : 7 respectively as in pea flower plant which means that the dominant character (pink colour) ratio is $\frac{9}{16}$ (i.e. the percentage is about 56%).

5 (a) • $AAbb \times aaBb$

• $Aabb \times aaBB$

(b) • $Aabb$

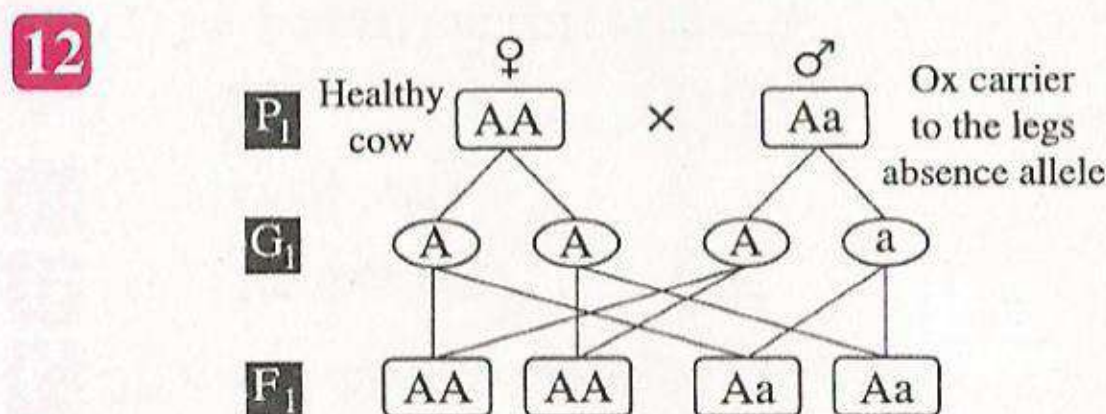
• $aaBb$

6 (a) A case of complementary genes.

(b) Due to the presence of two pairs of genes, where one of them is in the dominant state

and the other is in the recessive state. So, the recessive character (brown colour) appears. But the appearance of the dominant character (black colour) requires the convergence of a dominant gene or more from each pair of genes.

- 7** Because the inheritance of yellow-coloured fur in mice represents a dominant lethal genes case at which the presence of a pair of dominant genes of yellow colour in a pure form (YY) leads to stopping some vital processes and causes the death of yellow mice inside their mother's uterus.
- 8** Because the individuals carrying the genes of the trait in a pure state will die.
- 9** Yellow-coloured seedlings will grow, then they wilt and die after a period of time, due to the absence of light which is necessary for the gene of chlorophyll formation to show its effect. So, the plant is unable to form the chlorophyll pigment.
- 10** As this represents a case of recessive lethal genes at which the convergence of a pair of recessive genes during the inheritance of swelled-head character in a cat strain causes the death of $\frac{1}{4}$ of the generation (25%) after a short time of birth, due to the stopping of some vital processes.
- 11** The inner leaves will convert into green colour, due to the effect of green chlorophyll gene which needs to light to appear its effect.



Parents	Gametes	Resulted generation
AA × AA	(A) (A) × (A) (A)	AA AA AA AA
AA × Aa	(A) (A) × (A) (a)	AA AA Aa Aa
AA × Aa	(A) (A) × (A) (a)	AA AA Aa Aa
Aa × Aa	(A) (a) × (A) (a)	AA Aa Aa aa

Each individual with genotype (aa) dies and this genotype fails to appear in the resulted adult offspring. So, the ratio of the resulted adult offspring is :

$$\begin{array}{ccc} \text{i.e :} & 9 \boxed{AA} & : & 6 \boxed{Aa} \\ & 3 \boxed{AA} & : & 2 \boxed{Aa} \end{array}$$

Healthy individuals Individuals carrier to the legs absence allele

Answers of Model Exam on Chapter 2

- 1** (C) Each gene affects the resulted individual.
- 2** (a) 33.3%
 As when a crossing occurs between male and female yellow fur mice (hybrid), yellow and grey-coloured fur mice are produced with a ratio 3 yellow : 1 grey, if we assumed the presence of living yellow fur mice (pure) with a ratio $\frac{1}{3}$ from the total ratio of yellow fur mice ($\frac{1}{3} \times 100 = 33.3\%$).
- 3** (b) 50%
- 4** (b) B (hybrid) × A (hybrid).
- 5** (c) aaBb
- 6** (b) aaBB
- 7** (a) O⁻
 As the surface of RBCs of blood group (O⁻) is free from antigens (A) and (B) and also Rhesus factor antigens.
- 8** (b) AB⁺
 As the surface of RBCs of blood group (AB⁺) contains antigens (A) and (B) and also Rhesus factor antigens.
- 9** (d) two different genotypes and two different phenotypes.
- 10** (d) the seeds genotype is (Cc) + light presence.
 As the presence of gene (C) that is responsible for the formation of chlorophyll pigment in the genotype of corn seeds (Cc) in the presence of light leads to the appearance of the effect of chlorophyll gene. So, the seedlings are green in colour.

- 11 • Explanation :** as when cats with grey-coloured hair (BW) are crossed, two genes of the black hair character (BB) are gathered together in the individuals of the resulted generation, and so the black hair character is appeared. Also the two genes of the white hair character (WW) are gathered together. So, the white hair colour character is appeared and these traits are new and are different from the parents' traits.
- This case represents the lack of dominance case, because the ratio of the resulted generation was 6 : 12 : 5 (i.e. it is about 1 : 2 : 1) and new traits appeared different from that of the parents.

- 12 (a)** The blood group (B^-).
- (b)** The blood groups that can receive blood from this person : (AB^- , AB^+ , B^- and B^+).

- 13** As the gene of chlorophyll presence (C) is dominant over the gene of chlorophyll absence (c), when cultivating some corn seeds, some of them are white-coloured due to the presence of a recessive lethal gene in a pure form (cc) that is the chlorophyll absence gene and the convergence of a pair of recessive genes (in pure state) leads to the prevention of chlorophyll pigment formation that acquires the plants their green colour. So, the white-coloured seedlings wilt and die, representing $\frac{1}{4}$ of the resulted generation (25%). The inheritance of this character takes place through heterozygous (hybrid) parents in their genotypes (Cc). Therefore, some seedlings are white-coloured and the others are green-coloured.

- 14 •** 100% • 1 : 2 : 1

- 15** The mice will live, because the gene of grey fur colour (y) is a recessive gene, where the inheritance of yellow fur colour in mice is a dominant lethal genes case. So, two dominant lethal genes (YY) must be present to cause the death of mice. Therefore, when crossing hybrid yellow-coloured fur male and female, hybrid yellow mice and grey-coloured mice are produced with a ratio 2 : 1 and will live, while the pure yellow mice will die inside the uterus.

- 16 (1)** Recessive lethal genes.
(2) Lack of dominance.
(3) Dominant lethal genes.
(4) Complementary genes.
(5) Mendel's second law.

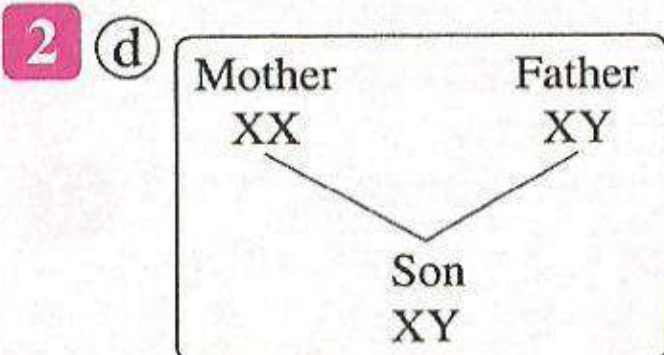
- 17** The blood group of the two women : (AB).

Answers of Chapter Three

Lesson 1

First Answers of Multiple Choice Questions

1 (c) Y / XX



3 (1) (d) X - 1

(2) (d) 2X - 2

(3) (b) 2X

4 (c) Its presence causes the differentiation of gonads in the sixth week of pregnancy. ,
(e) It is larger in size than chromosome no. (7) in the karyotype of the ovum.

5 (c) the male is responsible for the sex determination. ,
(e) each of male and female contains the long sex chromosome.

6 (b) one and half

7 (b) genital organs are differentiated after three months

8 (1) (c) the males are responsible for the sex determination.

(2) (a) 76

(3) (c) 38

9 (1) (a) before the first week.

(2) (b) 7th

(3) (d) 13th

10 (d) normal male

11 (c) normal female.

12 (d) the ovum dies after fertilization.

13 (b) presence of chromosome (Y).

14 (c) type of sex chromosomes.

15 (1) (c) (3). (2) (c) (3).

(3) (a) (1).

(4) (b) (4).

16 (d) absence of chromosome (Y).

17 (a) 22

18 (d) 47

19 (c) a female with Down's syndrome

20 (c) a male with Down's syndrome

∴ In this case, the human female ovum contains 24 chromosomes including only one sex chromosome that differs from the sex chromosome of the sperm.

∴ The chromosomal structure of this abnormal ovum is (23 + X). So, the chromosomal structure of the normal sperm is (22 + Y).

i.e. The fusion of the sperm nucleus with the ovum nucleus leads to the probability of the appearance of a male with Down's syndrome (45 + XY).

21 (c) A kidney cell of a female with Turner's syndrome.

22 (b)

23 (c) 1 : 2

24 (a) Klinefelter's syndrome.

25 (d) Normal female.

26 (1) (d) abnormal ovum. (2) (a) Polyploidy.

27 (1) (d) (a) or (b).

As this karyotype contains chromosomes in a single form (22 autosomes + one sex chromosome (X)), i.e. it represents a karyotype for a normal sperm carrying chromosome (X) or a normal ovum.

(2) (d) (L).

As the gene of the blood groups is carried on the chromosome no. (9), i.e. it is represented by symbol (L) in this figure.

(3) (b) Turner's syndrome.

As when the chromosome (Z) is absent (i.e. the absence of the sex chromosome (X)), it results in an abnormal ovum whose chromosomal structure is (22 + 0). So, on the fusion of this ovum with a normal sperm with chromosomal structure (22 + X), it leads to the appearance of Turner's case with chromosomal structure (44 + X0).

28 (b) female.

29 (d) a normal female.

30 (1) (d) the order of autosomes.

As the cells of individual (L) and (Z) contain one sex chromosome (X) and each one represents an abnormal chromosomal case. So, it is expected that they represent Turner's syndrome (44 + X0) and male with Down's syndrome (45 + XY), i.e. they are similar to each other in the order of autosomes according to their sizes from no. (1 : 22).

- (2) (c) a male with Klinefelter's syndrome or a female with Down's syndrome.

As the chromosomal structure of a somatic cell in a male with Klinefelter's syndrome is $(44 + XXY)$ and the chromosomal structure of a somatic cell in a female with Down's syndrome is $(45 + XX)$, i.e. both of them share in the presence of a pair of sex chromosomes (XX).

- 31 (b) 21 / 3

- 32 (d) three months.

As the embryo that doesn't carry chromosome (Y) (as in Turner's syndrome) starts forming the two ovaries after 12 weeks (i.e. three months) from the beginning of pregnancy, then the other female genital organs will be differentiated.

- 33 (b) The father's chromosomes.

- 34 (c) male who suffers from Down's syndrome.

- 35 (c) normal male.

- 36 (b) Either chromosome (X) or (Y).

Second Answers of Miscellaneous Questions

- 1 (a) 19 chromosomes.

(b) 36 somatic chromosomes (autosomes).

(c) One sex chromosome.

- 2 (a) Hormones. (b) Two testes.

- 3 After 6 weeks from the beginning of pregnancy, the fetus who carries chromosome (Y) starts to produce hormones that stimulate the tissues of the gonads (which are undifferentiated) to form the two testes, then the rest of the male genital organs will be differentiated.

- 4 The fetus who doesn't carry chromosome (Y) starts forming the two ovaries after 12 weeks from the beginning of pregnancy, then the rest of the female genital organs will be differentiated.

- 5 Sometimes during the gametes formation by meiosis, errors take place which cause the sex chromosomes to be unequally distributed, resulting in the arising of abnormal chromosomal cases, due to increasing or decreasing in the number of sex chromosomes, as in Klinefelter's and Turner's syndromes. So, if an abnormal ovum that contains two sex chromosomes (XX) is fertilized by a sperm containing the sex chromosome (Y), the

chromosomal structure of the resulted fetus will be $(44 + XXY)$ and grows into an abnormal male with symptoms of Klinefelter's syndrome. Whereas if an ovum that is devoid of the sex chromosome (X) is fertilized by a sperm that contains the sex chromosome (X), an individual containing one sex chromosome of type (X) arises, i.e. the total number of chromosomes will be $(44 + X0)$ and grows into an abnormal female who suffers from the symptoms of Turner's syndrome.

- 6 (a) A male with Down's syndrome.
(b) $(45 + XY)$.

- 7 **The statement is correct** / As the case of Klinefelter's syndrome appears, due to the presence of an extra chromosome (X), while the case of Down's syndrome appears, due to the presence of three copies of the somatic chromosome no. (21).

- 8 Due to the presence of chromosome (Y) in Klinefelter's syndrome. So, he is a male carrying the chromosomal structure $(44 + XXY)$, while the absence of chromosome (Y) in Turner's syndrome indicates that it is a female carrying the chromosomal structure $(44 + X0)$.

- 9 **The statement is correct** / As the disturbance that takes place during the formation of gametes by meiotic division, results in the adhesion of a pair of somatic chromosomes. So, an abnormal individual is produced after fertilization, due to the increase in the number of autosomes as in Down's syndrome "i.e it is arising, due to the presence of three copies of the chromosomes pair no. (21)".

- 10 Because this case is arising, due to the abnormality in autosomes "i.e. the presence of three copies of the chromosomes pair no. (21)", and doesn't take place, due to the abnormality in sex chromosomes.

- 11 (a) Klinefelter's syndrome $(44 + XXY)$.
(b) Turner's syndrome $(44 + X0)$.

- 12 (a) The error occurs in the formation of sperms /As the pair of autosomes no. (21) is transferred to one gamete and the other gamete is devoid of the copy of this autosome.
(b) A male with Down's syndrome.

13 The statement is correct / As the female with Down's syndrome contains a pair of sex chromosomes (XX), but she suffers from congenital defects, due to the presence of three copies of chromosome no. (21).

14 The number of genes increases in the male with Klinefelter's syndrome compared to the number of genes in the normal male / due to the presence of an extra chromosome (X).

15 The statement is wrong / As the somatic cells in Klinefelter's syndrome contain two sex chromosomes (XX), but they represent a male, due to the presence of sex chromosome (Y). So, his chromosomal structure is (44 + XXY).

- 16** (a) The chromosomal structure of individual (Y) may be :
- (44 + XX) a normal female.
 - (44 + XXY) a male with Klinefelter's syndrome.
- (b) Individual (L) that represents a female with Turner's syndrome (44 + XO).

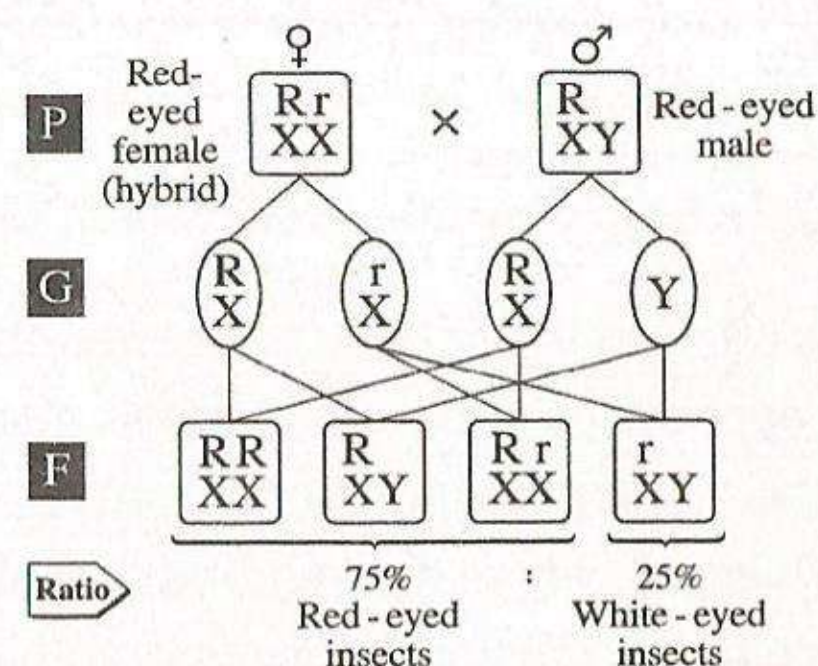
17

	Karyotype (1)	Karyotype (2)
Error type :	The presence of an extra sex chromosome (X).	The presence of an extra autosome in pair no. (21)
Name of the case :	Klinefelter's syndrome.	Down's syndrome.
Sex :	Male	Female

Lesson 2

First Answers of Multiple Choice Questions

- 1** (d) white-eyed male crossed with red-eyed female (hybrid).
- 2** (d) White-eyed female.
- 3** (c) $\frac{r}{X}X \times \frac{R}{X}Y$
- 4** (b) $\frac{R}{X}X \times \frac{R}{X}Y$
- As when crossing of the red-eyed female of *Drosophila* insect (hybrid) takes place with a red-eyed male of *Drosophila* insect, 75% red-eyed insects and 25% white-eyed insects (recessive character) are produced, as follows :



- 5** (b) It spreads among males more than females.
- 6** (c) the father is not a carrier for the allele of the disease.
- 7** (a) all males
- 8** (d) (b) or (c).
- 9** (a) 25%
- 10** (b) 50%
- 11** (a) All the children are normal.
- 12** (a) 0%
- 13** (c) A carrier mother to haemophilia disease and a normal father.
- 14** (d) it is impossible for the man to be the father of this child.
- 15** (c) Haemophilia doesn't appear on all daughters.
- 16** (d) sons.
- 17** (d) mother is a carrier for the gene of the disease and the father is infected.
- (e) mother and father are infected.
- As the trait of the haemophilia disease in female is represented by a pair of genes ($\frac{h}{X}\frac{h}{X}$), where she inherits one gene that is carried on chromosome (X) from the infected father and inherits the other gene from the mother whether she is a carrier for the disease ($\frac{H}{X}\frac{h}{X}$) or infected ($\frac{h}{X}\frac{h}{X}$). So, the genotype of the infected daughter is ($\frac{h}{X}\frac{h}{X}$).
- 18** (1) (b) the mother's father suffers from short-sightedness.
- (2) (d) $\frac{S}{X}Y \times \frac{S}{X}X$
- 19** (b) $\frac{A}{X}X \times \frac{A}{X}Y$, (d) $\frac{a}{X}X \times \frac{A}{X}Y$
- 20** (b) A white-eyed *Drosophila* male insect.
- 21** (b) It is inherited from the mother to her sons and daughters.

22 (b) $\overset{A}{X}\overset{a}{X}$,
(d) $\overset{A}{X}Y$

23 (b) 50%

24 (a) It is affected by the male sex hormones.
As the appearance of the effect of this gene on Ahmed not Mona means that this trait is sex-influenced, where the trait is appeared in the presence of one dominant gene only with the male sex hormones.

25 (c) The presence of one gene is enough for the trait to appear in females.

26 (c) both of them spread among males more than females.

27 (d) 100%

28 (d) the horns trait.

29 (c) $\frac{3}{4}$

30 (d) The gene of milk production is affected by the female sex hormones.

Second Answers of Miscellaneous Questions

1 Because the gene of the red-eyed colour (R) is dominant over the gene of white-eyed colour (r). So, the presence of one gene of the dominant character (red colour) on one of the sex chromosomes (XX) will prevent the appearance of the white colour (recessive). So, the appearance of the white-eyed colour character needs the presence of two recessive genes on the sex chromosomes pair ($\overset{r}{X}\overset{r}{X}$) and this is rare in females.

2

Sex chromosome (X) in human	Sex chromosome (Y) in human
<ul style="list-style-type: none"> It is found in the cells of human male and female. It is tall. It carries the genes that are responsible for the formation of the female gonads. It carries the genes of sex-linked traits. 	<ul style="list-style-type: none"> It is found in the cells of human male only. It is short. It carries the genes that are responsible for the formation of the male gonads. It carries a few genes of sex-linked traits.

3 The genotype of the red-eyed male : ($\overset{A}{X}Y$).

4 • The individual no. (1) (female) will be shaded / Its genotype is ($\overset{r}{X}\overset{r}{X}$).
• The individual no. (3) (male) will be shaded / Its genotype is ($\overset{r}{X}Y$).

5 Because the eye colour character genes in *Drosophila* are carried on the sex chromosome (X) only, (i.e. it is sex-linked trait). So, the presence of one gene only in male is enough for the emergence of the trait, producing a red-eyed male ($\overset{R}{X}Y$) or white-eyed male ($\overset{r}{X}Y$). So, males are always pure.

6 Because the colour blindness trait is sex-linked trait in human, where the genes of this trait are carried on sex chromosome (X). As the male cells contain one sex chromosome (X). So, the male to be infected with colour blindness, it is enough the presence of one gene only to appear this trait, as the sex chromosome (Y) doesn't carry the genes of the trait, whereas for the female to be infected with colour blindness, it requires the presence of two genes on the sex chromosomes pair (XX). So, this disease is more common among males.

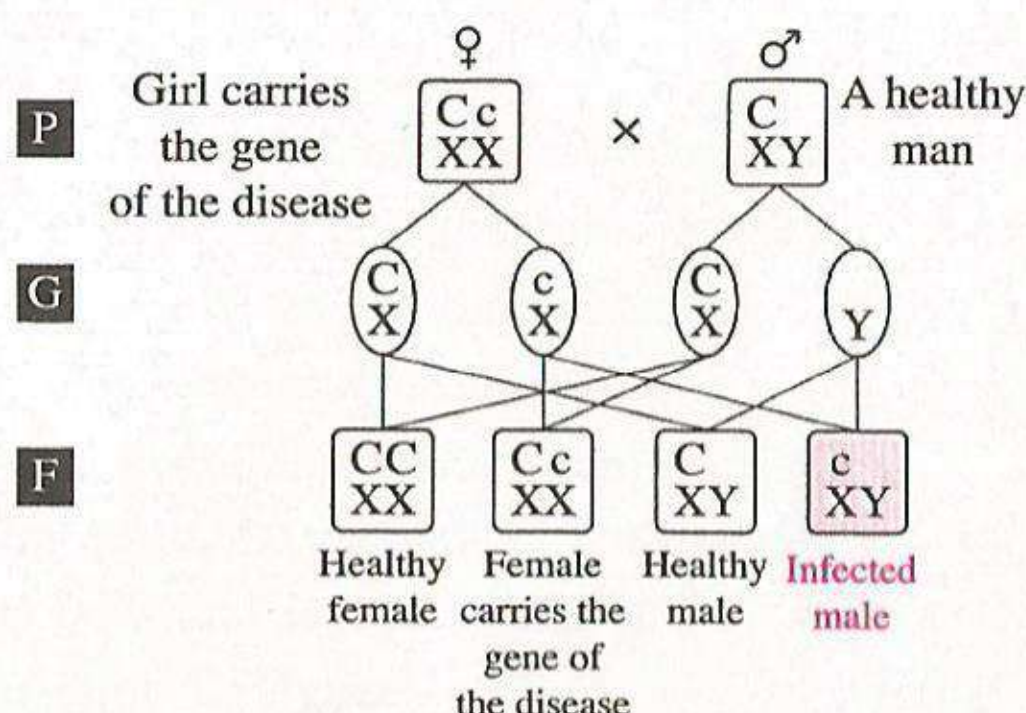
7 (a) The genotype of gamete (A) is : $\overset{c}{X}$

(b) Because the genes of sex-linked traits in human are carried on the sex chromosome (X) and the cells of the normal male contain only one sex chromosome (X). So, the presence of one gene only in male is enough for the emergence of the trait. So, males are always pure in the sex-linked traits, as they are normal or infected and there are no males carrying the gene of the disease.

8 Because the colour blindness character is a sex-linked trait carried on the sex chromosome (X) only and is not carried on the sex chromosome (Y). So, this character passes from the father to his daughters only, then it will be transferred later from the daughters to the grandsons through the inheritance of the same chromosome that carries the gene of the disease from the mother.

- 9 Mariam's father suffers from the colour blindness disease, as Mariam can't distinguish colours, especially the red and green colours. Therefore, this case belongs to the sex-linked traits, as Mariam inherits the gene of the colour blindness from her infected father and the other gene from her mother.

- 10 The girl carries the gene of the disease, because the mother is infected and the father is healthy. So, her genotype is $(\overset{C}{X}\overset{c}{X})$:



∴ The possibility of the appearance of the disease among sons is 50%

- 11 Because the appearance of this trait is controlled by a dominant gene that is responsible for hair falling which is carried on an autosome and influenced only by the masculinity (male) hormones. So, this trait appears in:
- Males, as it is enough for the trait to appear on the presence of one gene only. So, this trait appears in males with pure genotype (B^+B^+) and hybrid genotype (B^+B).
 - Females, the trait appears only in the pure genotype (B^+B^+). So it is necessary for appearing the hair falling trait in females, the presence of both genes together.

- 12 As the trait of baldness in males is from the sex-influenced traits and the appearance of the beard trait is from sex-limited traits and is restricted to males only. Therefore, both of them are affected by the male sex hormones.

Answers of Model Exam on Chapter 3

- 1 (d) 0%
- 2 (a) a male with Down's syndrome.
- 3 (c) $\overset{Hh}{XX} \times \overset{h}{XY}$

- 4 (d) the number of chromosomes in the somatic cell.

- 5 (d) the mother carries the gene of the disease and the father is infected.

As the birth of a haemophilic daughter with genotype $(\overset{h}{X}\overset{h}{X})$ means that this girl inherited one gene of the disease from her father and the other gene from her mother. So, the mother must be a carrier for the gene of the disease $(\overset{H}{X}\overset{h}{X})$ and the father is infected $(\overset{h}{X}Y)$.

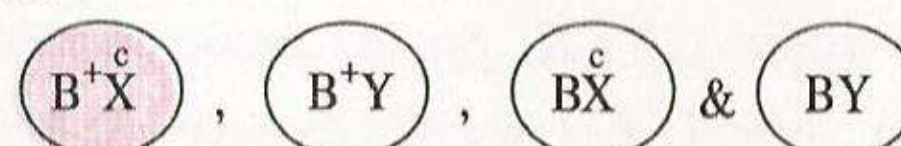
- 6 (d) 45 + X0

- 7 (d) 0%

- 8 (b) $\overset{c}{X}\overset{c}{X}Y$

- 9 (c) 25%

As the percentage of gametes that carry the genes of the colour blindness and baldness in the genotype $(B^+\overset{c}{X}Y)$ can be known by identifying the gametes that carry the genes of the colour blindness ($\overset{c}{X}$) and the baldness (B^+) together, as follows:

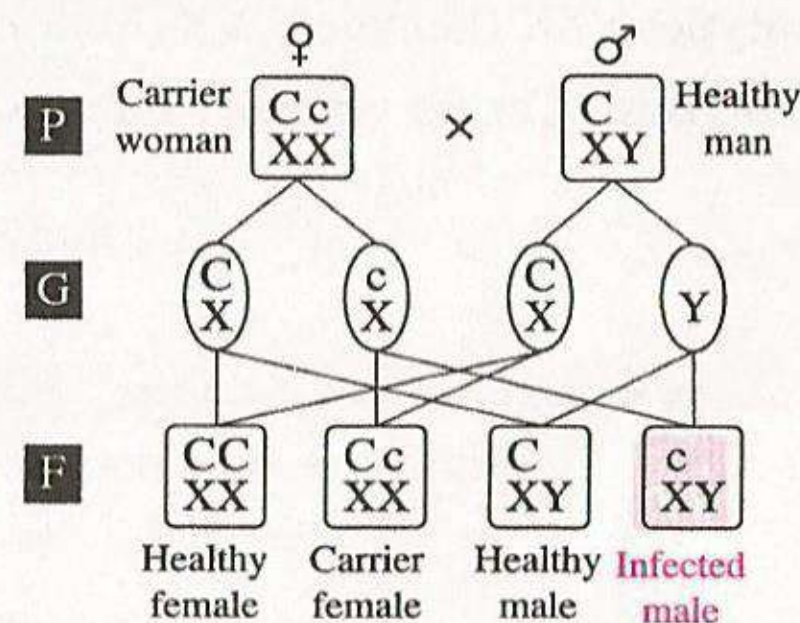


∴ The percentage is 25%

- 10 (a) Half the males are infected and all females are normal.

∴ The colour blindness case appears in some children, although both parents don't suffer from the colour blindness, where the gene of the disease carried on the sex chromosome (X).

∴ The mother must be a carrier for the gene of the disease $(\overset{C}{X}\overset{c}{X})$. So, the gene of the disease is transferred to the sons:



i.e. Half the males are infected and all females are normal.

11

	Colour blindness case	Baldness case
Similarity :	<ul style="list-style-type: none"> The appearance of both traits in females requires the presence of both genes together (pure form). So, both them spread among males than females. <p>Or</p> <ul style="list-style-type: none"> Mother passes the genes to both sexes. 	
Difference :	Answer by yourself.	

- 12 (1) $44 + X0$ / Female with Turner's syndrome.
 (2) $44 + XY$ / Healthy male.
 (3) $44 + XXY$ / Male with Klinefelter's syndrome.
 (4) $45 + XX$ / Female with Down's syndrome.
 (5) $45 + XY$ / Male with Down's syndrome.

- 13 (a) Female / Because the embryo is resulted from the fertilization of an ovum ($22 + \overset{C}{X}$) with a sperm ($22 + \overset{C}{X}$). So, the genotype is ($44 + \overset{C}{XX}$).
 (b) Normal / Because the embryo is a carrier for the gene of the disease in a single form (hybrid).

14 Answer by yourself.

- 15 (1) $\overset{Hh}{XX}$ (2) $\overset{H}{XY}$
 (3) $\overset{hh}{XX}$ (4) $\overset{h}{XY}$

- 16 (1) Carrier female. (2) Healthy male.
 (3) Infected female. (4) Infected male.

- 17 • Genotypes : $\overset{Hh}{XX}$ (Female), $\overset{h}{XY}$ (Male).
 • Phenotypes : Carrier woman / Infected man.

Unit Four

Answers of Chapter One

First Answers of Multiple Choice Questions

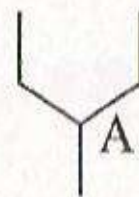
1 (b) mode of nutrition. , (e) mode of living.

2 (b) it doesn't be able to reproduce.

3 (a) individuals.

4 (b)

As mule is produced from the mating of a female horse with a male donkey. So, it is a sterile individual, unable to mate, reproduce and produce a new generation of the same species. Therefore, the second generation will not be found as represented in the opposite figure.



5 (b) the mating of (Y) and (Z) produces individuals belong to (X).

6 (c)

7 (a) Y

8 (a) the number of individuals in (A) is greater than the number of individuals in (B).

9 (1) (a) phylum.

As the phylum is the highest level in the taxonomic hierarchy which includes the greatest groups (organisms) in the illustrated hierarchy figure, as level (6) represents the least number which is (species). Therefore, level (1) represents the highest number which is (phylum).

(2) (b) Order.

As the order is the least level in the taxonomic hierarchy which includes the organisms (L) and (Z) together.

(3) (c) The two statements are correct.

As the organisms (M) and (L) are found in most of the taxonomic levels. So, they share the most common characteristics with each other, while organisms (M) and (E) are found in less taxonomic levels with each other. So, they share less characteristics with each other.

(4) (d) The two statements are wrong.

As organism (X) found with organism (Y) in the taxonomic level (1) only. So, organism (X) shares less characteristics with organism (Y), while organism (X) found with organism (M) in most of the taxonomic levels. So, it shares more characteristics with organism (M).

10 (1) (b) Y

As class Mammalia includes a number of orders and each order includes a large number of families and each family includes a large number of genera and each genus includes a large number of species and each species includes a large number of individuals. So, we found that the number of taxonomic levels increases as we go from class to species, (i.e. the least number is the order (29) followed by the families (153) followed by the genera (1230) then followed by the species (5700). So, (Y) represents the number of Mammalia genera (1230).

(2) (b) The taxonomic level (L) represents a part of the taxonomic level (X).

The taxonomic level (L) (family) represents a part of the taxonomic level (X) (order), as the order includes a group of families.

(3) (c) Z

As the species (Z) includes a group of individuals which have the ability to mate and produce a fertile generation of the same species.

11 (d) Kingdom.

12 (b) family. , (e) kingdom.

13 (d) class.

14 (c) genus and species.



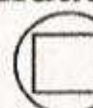
15 (c) *Vicia faba*. , (e) *Vicia faba*.

16 (d) species.

17 (d) 1

18 (a) Phylum.

19 (b)

As order Carnivora  includes a group of families such as Felidae family , so, their relationship will be .

20 (d) *Triticum aestivum*.

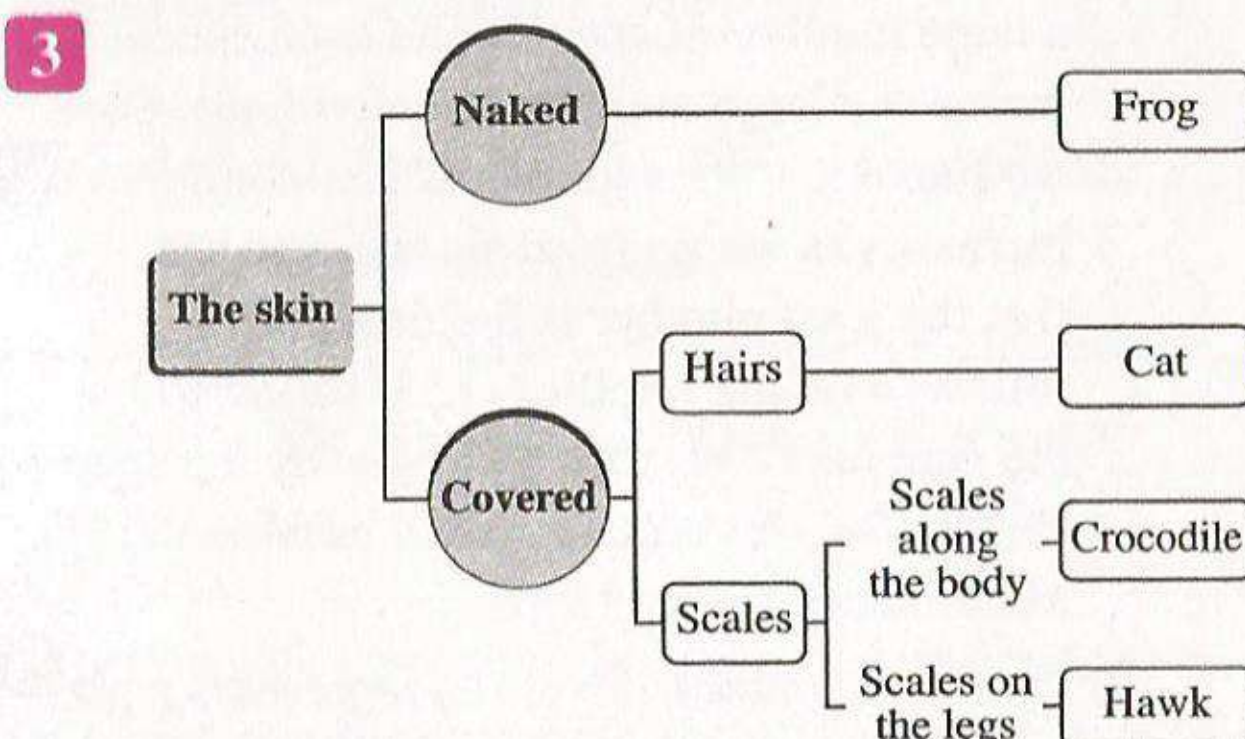
21 (c)

22 (c) the reproduction (sexual or asexual).

Second Answers of Miscellaneous Questions

1 There will be a difficulty in studying and identifying the living organisms.

2 The statement is correct / As there is a mating between two different species of living organisms, such as the mating between a female lion and a male tiger to produce tigon or the mating between a female horse and a male donkey to produce mule. So, these new individuals are not known as "species".



4 Organisms (A) and (B) belong to the same species, because they are able to mate with each other, reproduce and produce fertile (not sterile) individuals similar to them, also they inherit the new characters to their offsprings and that leads to increasing the number of individuals of the species (i.e. the ability to produce a new generation of the same species (A) and (B)).

5 (a)

	Mule	Tigon
Similarities :	<ul style="list-style-type: none"> Both of them produced from the crossing between two different species. Both of them are sterile and unable to reproduce. 	
Differences :	It is produced from crossing a female horse with a male donkey.	It is produced from crossing a female lion with a male tiger.

(b)

	Mule	Donkey
Similarity :	Both of them have some similar morphological characters (external shape).	

Differences :	• Sterile, can't produce new individuals.	• Fertile (not sterile), can produce new individuals.
	• Unable to mate and reproduce.	• Able to mate and reproduce.
	• It is produced from crossing a female horse with a male donkey.	• It is produced from crossing a female donkey with a male donkey.

6 The statement is wrong / Because there are other groups that intermediate each two successive groups of the taxonomic hierarchy as subphylum (located between phylum and class) and subclass (located between class and order).

- 7 (a) Organisms (A) and (B) don't belong to the same species / As the mating that occurred between organisms (A) and (B) produces a generation having the characters of the parents, but it is sterile and is not able to mate and produce new individuals of the same species.
- (b) The least taxonomic level in which organisms (A) and (B) share is the genus.

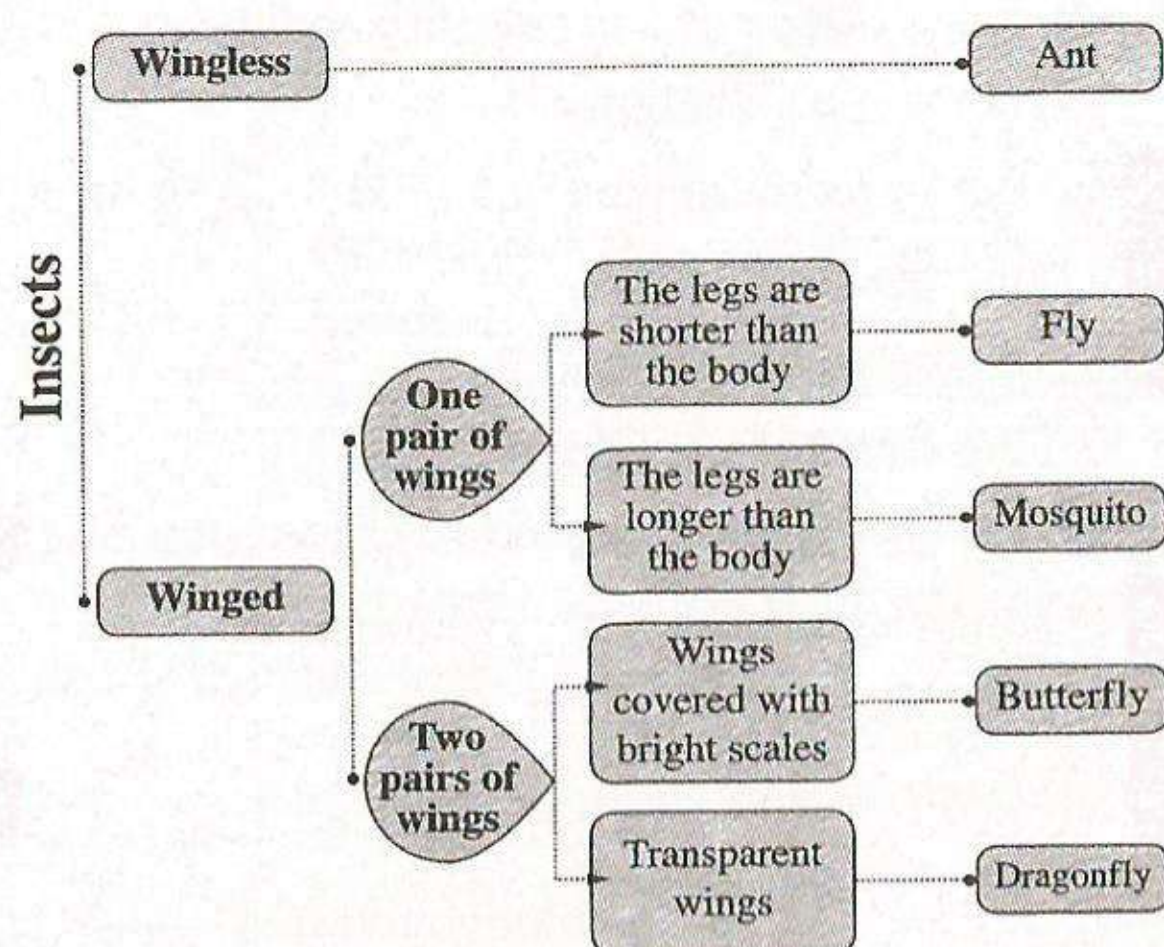
- 8 (1) Cat. (2) Rabbit.
(3) Fly. (4) Mosquito. (5) Spider.

9 The statement is wrong / As the need to name the living organisms with unified scientific names appears among scientists through the binomial nomenclature system, where the living organism may have many names that differ in various environments and Earth's regions.

10 The mistake : the dichotomous key illustrates the characteristics of living organisms in triplets (3 characters).

The correction : the dichotomous key illustrates the characteristics of the living organisms in pairs not in triplets, as one of the two descriptions is chosen according to the characteristics of the living organism in each step. So, insects are classified into winged or wingless.

The correct dichotomous key :



Answers of Model Exam on Chapter 1

- 1 (b) it is unable to mate and can't produce new individuals.
As the species is a term given for a group of organisms which have similar morphological characters, reproduce with each other and produce similar individuals to them. So, mule is not called species, as it can't mate, reproduce and produce new individuals.
- 2 (b) The first letters of genus and species are capital.
- 3 (a) family / order / subclass / class / subphylum / phylum.
As there are groups which intermediate each two successive taxonomic groups (levels) as subphylum (located between phylum and class) and subclass (located between class and order). So, the ascending order of the living organisms classification is : family / order / subclass / class / subphylum / phylum.
- 4 (b) preceding the genus and following the order.
- 5 (d) family.
- 6 (a) class.
- 7 (c)
- 8 (d) greater numbers and share less similar characters than the following group.

9 (b) Phylum.

10 (d) species.

11

	Tigon	Tiger
Similarities :	<ul style="list-style-type: none"> Both of them have some similar morphological characters (external shape). Both of them belong to kingdom Animalia. 	
Differences :	<ul style="list-style-type: none"> It is sterile, unable to mate, reproduce and produce a new generation of the same species. It is produced from crossing a female lion with a male tiger (two different species). 	<ul style="list-style-type: none"> It is fertile, able to mate, reproduce and produce a new generation of the same species. It is produced from crossing a female tiger with a male tiger (the same species).

- 12 They have one pair of wings.
- 13 Insect (B) has one pair of wings, while insect (D) has two pairs of wings covered with bright scales.
- 14 Insect (A) is a wingless insect, while insect (E) is winged insect (have two pairs of wings).
- 15 Answer by yourself.
- 16 Phylum Chordata is a higher taxonomic level which includes a number of classes such as class Mammalia.
- 17 The statement is wrong / As the genus includes a number of species. If a crossing occurred between two different species, they may produce sterile (infertile) individuals that are unable to mate, reproduce and produce a new generation of the same species, while the individuals of the same species can produce healthy and fertile offspring.

Answers of Chapter Two

Lesson 1

First Answers of Multiple Choice Questions

1 (b) Viroids. , (d) Prions.

2 (c) Prions.

3 (b) Malaria *Plasmodium*.

4 (c) Corona disease.

As the Corona disease is caused by a virus which considered from the organisms that gather between the characteristics of living organisms and the non-living things. So, it is not classified according to the modern classification system (Whittaker classification).

5 (b) Carolus Linnaeus.

6 (d) dividing mitotically only.

As all monerans reproduce asexually, i.e. they divide mitotically only.

7 (1) (c) It contains chlorophyll pigment.

(2) (b) the type of nucleus.

8 (d) The two statements are wrong.

9 (c)

As all monerans are prokaryotic organisms, as the nucleus has no definite shape, where the genetic material found in the cytoplasm is not surrounded by a nuclear membrane from outside.

10 (a) *Nostoc*. , (c) Spiral-shaped bacteria.

11 (c) cell membrane and cell wall.

As there are Archeabacteria in the sulphur hot spring in Helwan, while there are Eubacteria in the fresh water spring at Ain al-siliyin which is different from the Archeabacteria in the structure of the cell wall and cell membrane.

12 (a) It can't be seen by naked eye. ,

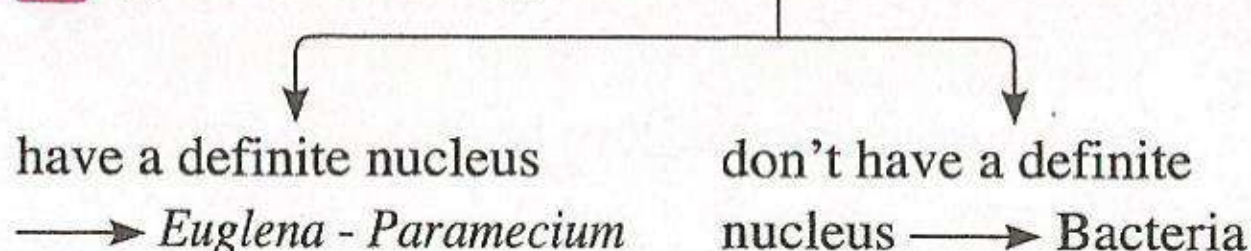
(d) It is rich in the membranous organelles.

13 (c) The mode of nutrition.

14 (c) that it is autotrophic.

15 (a) *Amoeba*.

16 (b) Unicellular organisms



17 (1) (b) the mean of locomotion.

(2) (c) presence of a mean of locomotion.

(3) (a) being unicellular.

18 (a) the structure of the body.

19 (d) the type of nucleus.

20 (d) the mean of locomotion. ,

(e) the class they belong to.

21 (d) the type of pigments.

22 (a) dinoflagellate. , (e) *Euglena*.

23 (c) The mode of nutrition.

24 (b) *Euglena*.

25 (b) Unicellular — binucleated —→ (1)
— mononucleated —→ (2)

26 (1) (b) B (2) (d) D

(3) (d) *Euglena* and *Trypanosoma*

27 (c) Diatoms / Dinoflagellate / *Euglena*.

28 (c) have pectin in their cell walls. ,

(e) are heterotrophic organisms.

Second Answers of Miscellaneous Questions

1 (a) Archaeobacteria can be seen, as most of them survive in the harsh environmental conditions, as the high salty water as in the Dead Sea.

(b) • Kingdom Monera.

• General characteristics of kingdom

Monera are :

- Nucleus is prokaryotic.
- Cell wall is devoid of cellulose or pectin.
- Cytoplasm is lack of many membranous organelles, such as : mitochondria, plastids, Golgi apparatus and endoplasmic reticulum.

2 Eukaryotic / As the genetic material is surrounded by a nuclear envelope that separates it from the cytoplasm and the nucleus has a definite shape.

3 The statement is wrong / As Protozoa is classified into four classes according to the mean of locomotion which include class Sporozoa which contains organisms that have no mean of locomotion.

4

	<i>Nostoc</i>	<i>Amoeba</i>
Similarities :	Both of them are not complex in structure and they are unicellular organisms.	

Differences :	<ul style="list-style-type: none"> • It is prokaryotic organism. • The cytoplasm contains chlorophyll pigment. • It is autotrophic. 	<ul style="list-style-type: none"> • It is eukaryotic organism. • The cytoplasm doesn't contain chlorophyll pigment. • It is heterotrophic.
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5 The statement is wrong / As Pyrrophyta contain the red pigment which acquires them red colour, beside the chlorophyll pigment.

6 By the mean of locomotion, where :

- *Amoeba* : moves by pseudopodia.
- *Euglena* : moves by flagella.
- *Paramecium* : moves by cilia.

7 The statement is correct / As fishes and marine animals are found in the areas where the diatoms present in high amounts, because diatoms are considered an important source of food for them and this leads to an increase in the income of the fishermen who are fishing from this lake.

- 8** (a) • **Organism (1)** belongs to kingdom Plantae, because it is an autotrophic organism that performs photosynthesis.
- **Organisms (2), (3) and (4)** belong to kingdom Animalia, because they can move.
- (b) • **The similarities between organism (A) "Euglena" and organism (1) "Nostoc" :**
- Both of them are autotrophic and perform photosynthesis, because they contain chlorophyll pigment.
 - Both of them are unicellular and their body structure is not complex.
- **The similarities between organism (A) "Euglena" and organism (2) "Amoeba" :**
- Both of them are eukaryotic organisms.
 - Both of them are unicellular and their body structure is not complex.
 - Both of them are movable organisms.
- **The similarities between organism (A) "Euglena" and organism (3) "Rod-shaped bacteria (Bacilli)" :**
- Both of them are unicellular and their body structure is not complex.
 - Both of them are movable organisms.

- **The similarities between organism (A) "Euglena" and organism (4) "Trypanosoma" :**
 - Both of them are eukaryotic organisms.
 - Both of them are unicellular and their body structure is not complex.
 - Both of them move by flagella.

9 Because they are considered an important source of food for fish and other marine animals.

Lesson 2

First Answers of Multiple Choice Questions

- (d) multicellular.
- (b) yeast fungus.
- (b) multicellular zygomycete
- (1) (c) chitin.
(2) (b) producing spores.
- (c) bacteria.
- (1) (c) Fungi. (2) (d) they are able to move.
- (c) free-living
- (c) *Polysiphonia*.
- (1) (a) the structure of the body.
(2) (d) mean of locomotion.
- (d) *Penicillium* and *Plasmodium*
- (1) (b) marine weeds.
(2) (a) red and green (3) (b) the habitat.
- (b) the mean of locomotion.
- (d) The phylum they both belong to. ,
(e) The kingdom they both belong to.
- (1) (c) Rhodophyta - Phaeophyta - Chlorophyta
(2) (c) the types of pigments.
- (c) the number of green plastids. ,
(e) the phylum they both belong to.
- (d) the cell wall structure.
- (d) The structure of the body.
- (d) *Funaria*.
- (c) *Polysiphonia*.
- (c) *Pinus*.
- (d) Has needle-shaped leaves. ,
(e) Has pinnate-veined leaves.
As the vascular plants are divided into flowering plants "i.e. they form flowers" (Angiospermae) and non-flowering plants "i.e. they don't form flowers" such as : class Gymnospermae which carry simple needle-shaped leaves and class Filicatae which carry pinnate-shaped leaves.

- 22 (c) has fibrous roots.
 23 (c) has flowers with tetramerous whorls or their multiplies.
 24 (b) that the seeds are coated with pericarp.
 25 (c) flower structure.
 26 (d)
 27 (d) All fungi and some plants.
 28 (b) *Polypodium*.
 29 (b) trimerous
 30 (d) containing seeds.
 31 (d)

Second Answers of Miscellaneous Questions

- 1 **The statement is wrong** / As there are some unicellular organisms belong to different kingdoms like yeast fungus which belongs to kingdom Fungi and *Chlamydomonas* alga which belongs to kingdom Plantae.
- 2 As their cells contain different chromatophores according to the phylum they belong to, like phylum Rhodophyta that have cells contain chromatophores of red pigments. So, they are called red algae, phylum Phaeophyta that have cells contain chromatophores of brown pigments. So, they are called brown algae and phylum Chlorophyta that have cells contain chloroplasts. So, they are called green algae.
- 3 • Kingdom Plantae / Because it contains green plastids.
 • Kingdom Animalia / Because it moves by flagella as in some animals.
- 4 (a) The appearance of bread mould fungus that is grown on it (black putrefaction).
 (b) The source is the spores of this fungus that spread in air, then fall on the wet piece of bread where they germinate.
 (c) Because the conditions and factors needed for the germination of spores of bread mould fungus, such as humidity (water) are not available.
 (d) Phylum : Zygomycota.

- 5 *Riccia* plant can't perform photosynthesis process and it will lose the ability to grow and reproduce leading to its death.

- 6 As the green plants contain chloroplasts (green plastids) that contain chlorophyll pigment which is responsible for performing photosynthesis process, while fungi don't contain green plastids. So, they are heterotrophic, where some of them are parasites and the others are saprophytes.

- 7 **The ascending arrangement :**

Nostoc → *Diatoms* → *Penicillium* →
Chlamydomonas → *Polypodium*.

- 8 As Pyrrophyta belongs to kingdom Protista, is characterized by a simple structure, and moves by two flagella, while Rhodophyta belongs to kingdom Plantae, are complex-structured marine weeds that consist of filaments sticking together by a gelatinous coat and their cells contain chromatophores of red pigments.

- 9 **As the bean plant is characterized by :**

- Two cotyledonous seeds.
- Palmate-veined leaves.
- Tap roots.
- Bundles of vascular tissues are arranged in a ring inside the stem.
- Flowers with pentamerous whorls.

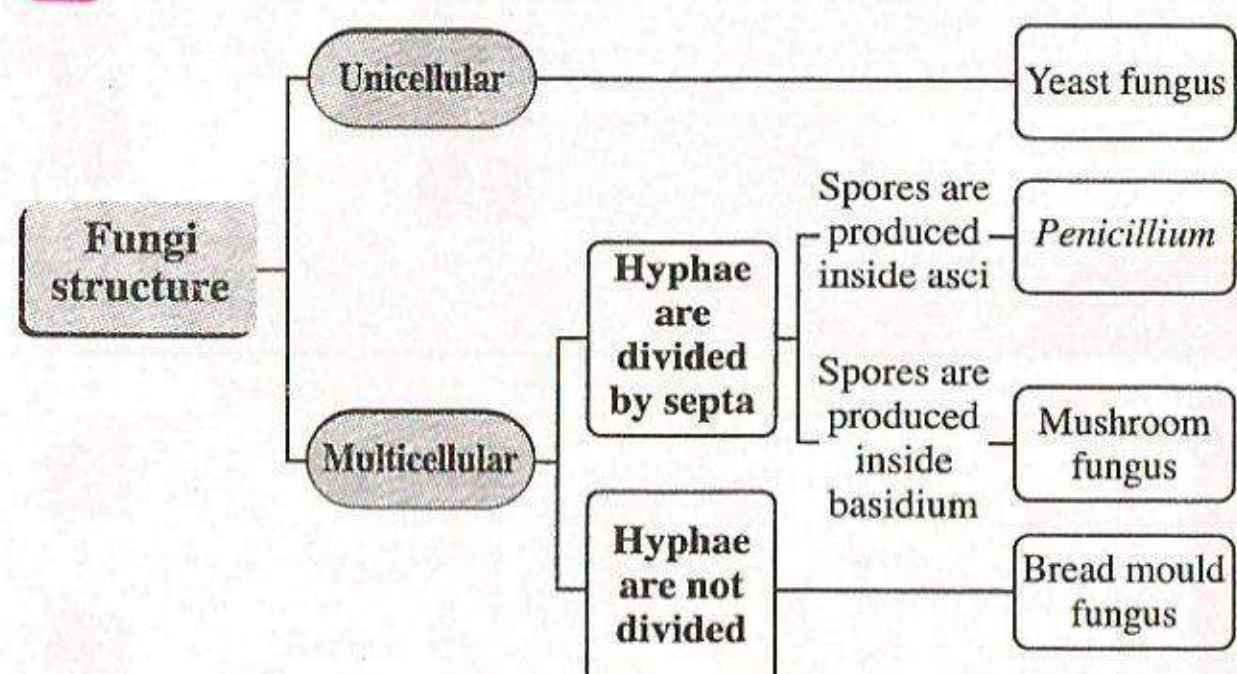
- 10 **The statement is wrong** / As *Polypodium* belongs to the vascular plants which contain specialized vascular tissues for transportation.

11

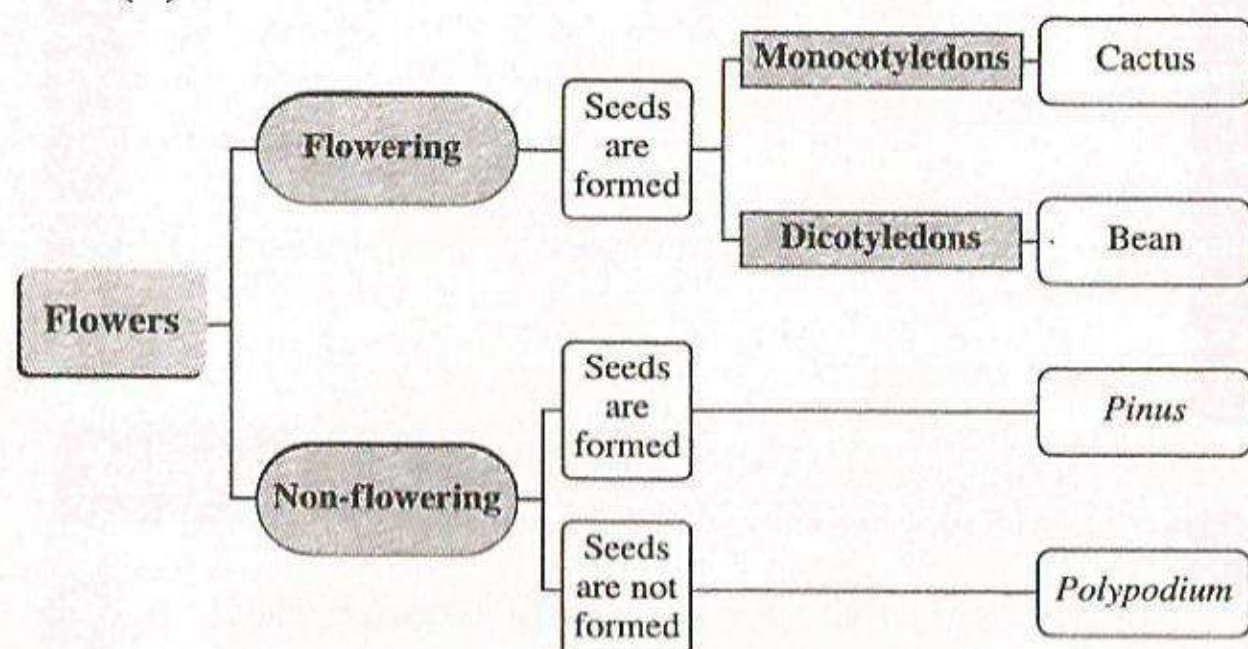
	Method of reproduction	Presence of xylem
(1)	Asexually by spores	Absent
(2)	Sexually	Present
(3)	Asexually by binary fission	Absent
(4)	Asexually by spores	Present
(5)	Sexually	Present

- 12 (1) *Spirogyra*. (2) *Polypodium*.
 (3) *Pinus*. (4) Maize.
 (5) Pea.

13 (a)



(b)



14 The statement is correct / As the *Chlamydomonas* alga which is a unicellular organism contains green plastids that perform photosynthesis process and belongs to kingdom Plantae.

Answers of Model Exam on Chapter 2

1 (d) the presence of their genetic material in the cytoplasm.

As the main reason for naming the organisms of this kingdom by monerans (Kingdom Monera) is that their genetic material is found in the cytoplasm and not surrounded by a nuclear membrane from outside, while the unicellular structure of the body is not considered the reason to belong to kingdom Monera and this is due to the presence of many unicellular organisms which are not monerans such as : *Amoeba* and *Paramecium* (kingdom Protista), as the devoid of pectin from their cell wall structure is not considered the reason to be monerans, as there are many organisms have no pectin in their cell walls such as : Diatoms (Chrysophyta), as the devoid of plastids is not considered the reason to be monerans, as there are many organisms have no plastids and not considered as monerans such as : Fungi.

2 (a) class Sarcodina.

3 (b) moving by flagella.

4 (c) being eukaryotic.

5 (a) the mean of locomotion.

6 (d) their cell walls consist of chitin.

7 (b) *Polysiphonia*.

8 (d) Plantae.

9 (b) they contain vascular tissues.

10 (c) Monocotyledons of Angiospermae.

11 (a) Phylum : Pyrrophyta.

(b) Heterotrophic nutrition / As this organism "Dinoflagellates" mostly contain red pigments (high percentage) beside the green plastids (low percentage) that are responsible to perform photosynthesis process.

12 Answer by yourself.

13 As the cell wall of Diatoms is glass-like cell walls which contain silica, while that of Chlorophyta contain cellulose.

14

The living organism	Kingdom	Explanation
Yeast fungus	Fungi	- It is eukaryotic, immobile and its cell wall contains lignin substance. - It reproduces by producing spores in a sac-like structure called asci.
<i>Amoeba</i>	Protista	It is eukaryotic, i.e. the genetic material is surrounded by a nuclear envelope that separates it from the cytoplasm, move by pseudopodia and its structure is not complex.

Bacteria	Monera	It is prokaryotic, i.e. the genetic material is not surrounded by a nuclear membrane (it doesn't have a definite shape), cell wall is devoid of cellulose or pectin and the cytoplasm is lack of many membranous organelles.
<i>Chlamydomonas</i>	Plantae	It is eukaryotic, the cell wall consists of cellulose and the cytoplasm contains chloroplasts that contain chlorophyll substance.

- 15 The statement is correct / As *Euglena* contains chloroplasts which are responsible for performing photosynthesis process, but it belongs to kingdom Protista.

16

	<i>Funaria</i> plant	<i>Pinus</i> plant
The phylum :	Bryophyta (Mosses).	Tracheophyta.
The vascular tissues :	Absent.	Present.

17

Alga	Its colour
<i>Polysiphonia</i>	Red
<i>Fucus</i>	Brown
<i>Spirogyra</i>	Green
Dinoflagellate	Red

Answers of Chapter Three

Lesson 1

First Answers of Multiple Choice Questions

- (c) it is immobile.
- (c) leeches. , (e) Earthworms.
- (b) All of them are unisexual.
- (a) They are parasites.
- (d) *Planaria*.
- (c) The mode of nutrition.
- (b) The symmetry of the body.
- (c)
- (c) the mode of living. , (e) the presence of true nucleus.
- (d)
As the higher the evolution of worms, the increasing of free-living mode and decreasing the mode of parasitism. So, when we move from phylum Platyhelminthes (flatworms) to phylum Nematoda (roundworms), then to phylum Annelida (ringworms), we found that the free-living mode increases and parasitism decreases, therefore there is a directly proportional relation between the evolution of worms and the free-living mode. So, the relation is :
- (d) Earthworm.
- (c) free-living character increases and parasitism decreases.
- (1) (a) (X).
(2) (a) Arachnida.
- (c) Class.
- (a) the appendages or segmented legs.
- (1) (d) the presence of an exoskeleton.
(2) (d) the division of the body into segments.
- (c) Sea cucumber – Octopus – *Aurelia*.
- (1) (b) Arachnida.
(2) (d) four pairs of walking legs.

- 19 (c) shape of wings.
 20 (d) its legs are shorter than its body.
 21 (c) The respiration method. ,
 (e) The phylum they both belong to.
 22 (1) (b) Insecta.
 (2) (c) the number of legs.
 23 (1) (c) the method of respiration.
 (2) (b) the number of body regions.
 24 (d) It moves by arms.
 25 (c) the unsegmented body.
 26 (c) having the ability to move.
 27 (c) Moving by arms.
 28 (b) the method of movement.
 29 (d)

Second Answers of Miscellaneous Questions

- 1 (a) Self-defence and capturing preys.
 (b) • **Organism (2)** "*Paramecium*" belongs to phylum : Protozoa.
 • **Organism (3)** "*Hydra*" belongs to phylum : Cnidaria.
 2 **The statement is correct** / As the Earthworms live inside the soil in burrows, where they aerate the soil and increase its fertility.
 3 The ringworms movement will be difficult.
 4 **The statement is wrong** / As class Crustacea belongs to phylum Arthropoda and covered with a chitinous cuticle.
 5 **The statement is wrong** / As the crab is from class Crustacea which breathes by gills, while mosquitoes are from class Insecta which breathes by tracheoles.
 6 Class Insecta / As it has three pairs of walking legs, two pairs of wings, one pair of compound eyes and one pair of antennae, and its body consists of three regions which are the head, thorax and abdomen.
 7 **The statement is wrong** / As antennae are found only in class Insecta in phylum Arthropoda, but the standard taxonomic level in the classification of arthropods is the number of legs.

- 8 • As the crab body consists of :
 - Two regions which are cephalothorax and abdomen, also it is covered with a chitinous cuticle.
 - Many jointed appendages that are modified into different forms to perform various functions.
 9 (a) **Organism (A)** : Oyster or desert snail or octopus.
Organism (B) : Prawn or crab (sea cancer) or lobster.

(b)

	Organism (A)	Organism (B)
The body division	The body is unsegmented.	The body is segmented.
The movement organ	A muscular part called foot.	Jointed appendages.

- 10 (a) Animal (A) is different from animal (B) in the number of body regions and the number of legs.
 (b) Animal (B) is different from animal (D) in the method of respiration.
 (c) Animal (C) is similar to animal (D) in the number of body regions.

11 (a)

	Organism (1) "Spider"	Organism (2) "Crab"
Similarities	<ul style="list-style-type: none"> The body is divided into two regions which are cephalothorax and abdomen that are covered by an exoskeleton. The body is divided into a number of segments which carry many pairs of appendages that are divided into several jointed pieces. 	
Differences	<ul style="list-style-type: none"> It has four pairs of walking legs. It has simple eyes. It breathes by tracheoles or lung books. 	<ul style="list-style-type: none"> It has many jointed appendages that are modified into different forms to perform various functions. It has compound eyes. It breathes by gills.

- (b) **Organism (1)** : belongs to class Arachnida.
Organism (2) : belongs to class Crustacea.

Lesson 2

First Answers of Multiple Choice Questions

- 1 (d) opened blood circulation.
- 2 (a) (X) is cold-blooded animal and (Y) is warm-blooded animal.
As animal (X) is from the cold-blooded animals that can't regulate their body temperature, where it changes according to the change in the surrounding environment. While animal (Y) is from the warm-blooded animals that their body temperature doesn't change a lot with the change of the environment temperature.
- 3 (c) scorpion. , (e) spider.
- 4 (b) (1) and (4).
- 5 (b) the presence of paired fins. ,
(e) the presence of tongue.
- 6 (a) the type of endoskeleton.
- 7 (b) Osteichthyes.
- 8 (a) method of respiration.
As the boliti fish (from class Osteichthyes) and the embryonic stage of toad (from class Amphibia) both breathe by gills.
- 9 (1) (a) adult stage of salamander
As the adult stage of salamander (from class Amphibia) is from the cold-blooded animals, where the fertilization occurs externally and the sexes are separated, the females lay eggs in water and breathe by lungs and skin as they live on land.
(2) (b) individuals of groups (X) and (Z).
As the individuals of group (X) (class Amphibia) are characterized by the external fertilization and the sexes are separated, as the females lay eggs and their adult stages breathe by skin and lungs as they live on land, while the embryonic stages breathe by gills as they live in water. So, group (X) can move in two different media (land and water), while group (Z) (class Reptilia) as crocodile is characterized by its ability to move in both water and land.
(3) (c) Individuals of group (Y) only.
As the individuals of group (Y) which

represent class Aves are characterized by being from the warm-blooded animals that their body temperature doesn't change a lot with the change in the environment temperature (i.e. by changing the year seasons).

- 10 (c) Mammalia and Amphibia.
- 11 (c) they have an operculum.
- 12 (b) having endoskeletons.
- 13 (c) the separation of sexes.
- 14 (a)
- 15 (c) Monera / Protista / Animalia
- 16 (d) Ray fish - Salamander - Lizard - Ostrich.
- 17 (d)
- 18 (c) horny scales.
- 19 (d) type of fertilization.
- 20 (c) lizard.
- 21 (a) ostrich.
- 22 (b) duck-billed platypus.
- 23 (d) Duck-billed platypus - Kangaroo - Armadillo.
- 24 (b) whale.
- 25 (c) Aves and Mammalia
- 26 (d) The embryo's growth place.
- 27 (b) the mother suckles its young.
- 28 (c) it breathes like the rest aquatic organisms.
- 29 (d) number of incisors in the lower jaw.
- 30 (c) the tail is short. , (e) the brain is big.
- 31 (c) the number of toes.
- 32 (c) the number of toes in the hind limbs.
- 33 (b) their young need care after birth.
- 34 (1) (a) Mammalia.
As organism (X) is from the cold-blooded animals. So, it can be classified as fishes or amphibians or reptiles, but can't be classified as class Mammalia (warm-blooded animals).

(2) (d) Aves.

As organism (Y) is from the warm-blooded animals. So, it can be classified as class Aves or Mammalia, but if the body is covered with feathers, it must be classified as class Aves.

(3) (b) the mean of locomotion.

As organism (Z) and organism (L) are from the warm-blooded animals and their bodies are covered with hair, therefore they must follow class Mammalia. So, they share the same type of fertilization (internal), the presence of mammary glands as the majority of the females have mammary glands secreting milk to suckle their young and they are separated in sexes (males and females). But they differ in the mean of locomotion as organism (Z) can fly, while organism (L) is from order Artiodactyla.

35 (a) it has a pair of incisors in the upper jaw.

36 (c) bat

37 (d) is active during night.

38 (1) (c) (Z).

As animal (Z) is characterized by the presence of wings and the females lay eggs. So, it follows class Aves which is characterized by the presence of air sacs in their bodies that act as storehouses for the additional amounts of oxygen during flying (i.e. this organism has spare storage of oxygen).

(2) (c) the shape of limbs.

As animal (Y) is considered from subclass Prototheria, due to the presence of hair on its body, the females don't give birth, but lay eggs and incubate them, while the fertilization is internal, they breathe by lungs and they are warm-blooded animals. while animal (L) is considered from subclass Eutheria (placental mammals), due to the presence of hair on its body and the presence of wings that are produced from the modification of the forelimbs into wings (order Chiroptera). So, animal (Y) differs from animal (L) in the shape of limbs.

(3) (a) (X).

As animal (X) is considered from class Reptilia, due to the presence of scales on its body, their females lay eggs and no wings or hair are found on their bodies.

Second Answers of Miscellaneous Questions

1 As *Lamprey* fish has a circular, funnel-shaped jawless mouth with a rough tongue that is provided with many horny teeth, it has no paired fins and its endoskeleton is cartilaginous.

2 Their body temperature will not change by changing the temperature of the surrounding environment. So, they will use the food energy to keep their body temperature constant.

3 The seagull will not be able to fly, as the solid bones increase the weight of the body and also the weak thoracic muscles will not be able to move the wings, leading to the movement obstruction.

4 (1) As salamander is characterized by the following :

- Body with a smooth slimy skin.
- Respiration takes place according to the stages of its growth :
 - Embryonic stage breathes by gills, because they live in water, while the adult stage breathes the atmospheric air by lungs and skin, because they live on land.

(2) The crocodile is characterized by the following :

- Its body covered by a dry skin with thick horny scales and it may be supported by horny plates.
- It breathes the atmospheric air by two lungs.

5 As :

- The bones are hollow and light.
- The sternum is broad for the attachment of the strong thoracic muscles which move the wings during flying.
- Its body contains air sacs which are considered the storehouses for the additional amounts of air during flying.

6 (a) *Euglena* / As it is a living organism that carries the characters of kingdom Plantae and kingdom Animalia, where it contains chloroplasts like plants to perform photosynthesis and moves by flagellum like some animals.

(b) **Duck-billed platypus** / As it is considered a link between class Aves and class Mammalia, where it lays eggs and incubates them like birds and the mother suckles its young with the milk that is secreted from the mammary glands on its abdomen like mammals.

7

(a)

1. Figure (1) "Pori"	Figure (5) "Frog"
<ul style="list-style-type: none"> - Class Osteichthyes. - It is covered by bony scales. - It breathes the oxygen which is dissolved in water by gills, because it lives in water. - It moves by medial and paired fins. 	<ul style="list-style-type: none"> - Class Amphibia. - It is covered by a moist skin. - The adult stages breathe the atmospheric air by lungs and skin, because it lives on land. - It moves by four pentadactyl limbs.

2. Figure (2) "Rabbit"	Figure (6) "Rat"
<ul style="list-style-type: none"> - It has two pairs of incisors in the upper jaw. - The tail is short. - The ears are long. 	<ul style="list-style-type: none"> - It has a pair of incisors in the upper jaw. - The tail is long. - The ears are small.

(b) 1. The similarities between figure (2) "rabbit" and figure (4) "ostrich" :

- Both of them are warm-blooded animals.
- They have a vertebral column which surrounds and protects the spinal cord.
- They have circulatory system which consists of a heart that consists of several chambers and blood vessels in which blood flows in a closed circulation to supply all the body organs with oxygen and nutrients.
- They breathe the atmospheric air by lungs.
- Their sexes are separated and the fertilization is internal.

2. The similarities between figure (3) "lizard" and figure (5) "frog" :

- Both of them are cold-blooded animals.
- They have four pentadactyl limbs.
- Their sexes are separated.

8 (a) (3), (5) and (6).

(b) (2), (3), (5) and (6).

9

Air sacs	Air bladder
<ul style="list-style-type: none"> - Found in birds. - Act as storehouses for the additional amounts of air during flying. 	<ul style="list-style-type: none"> - Found in the bony fishes. - Helps them in swimming and floating.

10 The kangaroo's young will remain immature which may lead to their death.

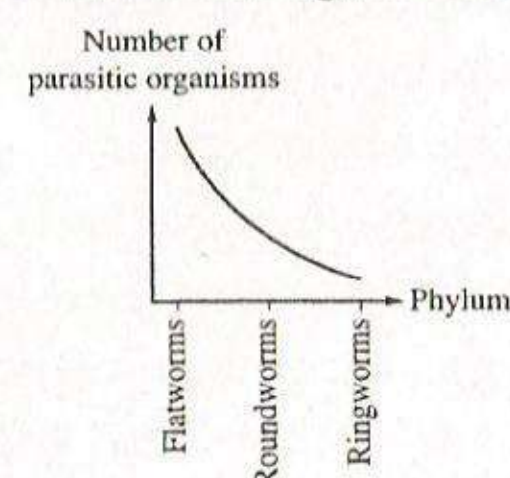
Answers of Model Exam on Chapter 3

1 (d) the number of incisors in the lower jaw.

2 (a) the body division.

3 (c)

As we move in the modern classification from phylum Platyhelminthes then to phylum Nematoda then to phylum Annelida, we found that the parasitism property decreases with the increasing of the free-living property, as there is an inversely relationship between the evolution of worms and the parasitic mode of living, as follows :



4 (b) the method of respiration.

5 (d) crab.

6 (d) the body is divided into head and trunk.

As all the organisms of phylum Arthropoda are characterized by having a body which carries many appendages composed of several segments and covered with an exoskeleton. As the method of respiration in class Arachnida, class Insecta and class Myriapoda (including this organism (*Scolopendra*) is breathing by tracheoles. So, what characterizes this organism (*Scolopendra*) that its body is divided into head and trunk.

7 (a) Earthworm.

8 (b) horny scales.

9 (b) gills.

10 (a) creeping.

- 11 • **Organism (X)** : class Osteichthyes.
 • **Organism (Y)** : class Crustacea.
 • **Organism (Z)** : class Mammalia.
 • **Organism (L)** : class Chondrichthyes.

12

	Ray fish	Pori (Mullet) fish
The type of fertilization :	Internal	External
The type of endoskeleton :	Cartilaginous	Bony

13 Because it is a placental animal which gives birth to a fully developed young (viviparous) and the mother suckles its young with the milk that is secreted from the mammary glands.

14 As they provide them light weight to help them in flying, where its sternum bone is broad for the attachment of the strong thoracic muscles which move the wings during flying.

15

	Organism (a) "Sea star"	Organism (b) "Octopus"
Differences :	<ul style="list-style-type: none"> * It belongs to phylum Echinodermata. * It has hard endoskeleton. * Its wall has spines and calcareous plates. * They move by tube-feet or spines or arms. 	<ul style="list-style-type: none"> * It belongs to phylum Mollusca. * It has soft mass. * It has a calcareous shell. * It uses foot in movement. * It has an organ that is similar to tongue carrying rows of teeth called radula.

- Sea star is more advanced than octopus.

16 Prawn and the embryonic stage of toad.

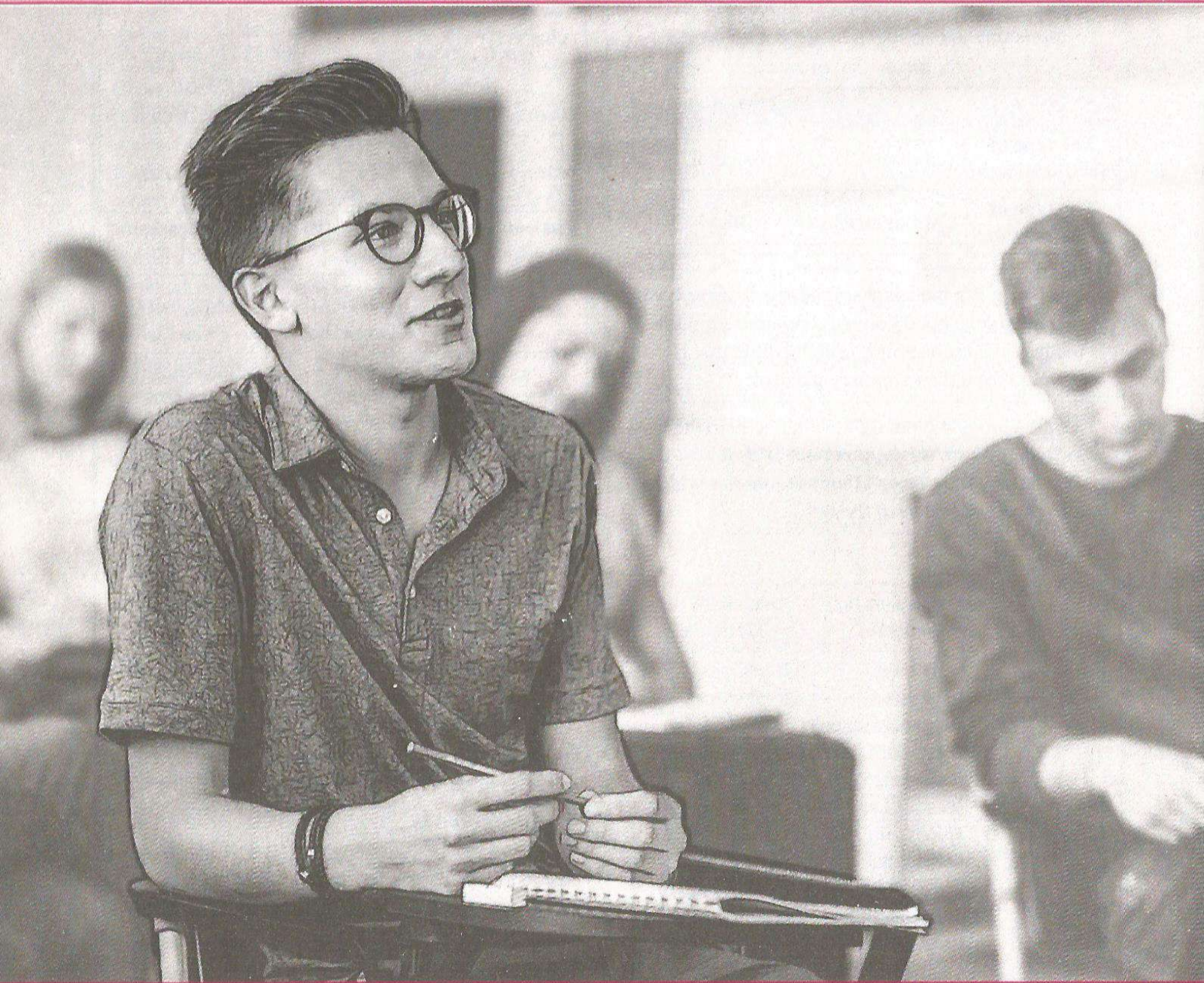
17

	Organism (a) "Crocodile"	Organism (b) "Hawk"
The different character :	<ul style="list-style-type: none"> * It belongs to class Reptilia. Or * It is a cold-blooded animal. Or * The body is covered by dry skin with thick horny scales. 	<ul style="list-style-type: none"> * It belongs to class Aves. Or * It is a warm-blooded animal. Or * The body is covered with feathers.
The common character :	* They breathe the atmospheric air by lungs.	

	Organism (c) "Kangaroo"	Organism (d) "Gorilla"
The different character :	<ul style="list-style-type: none"> * It belongs to subclass Metatheria. Or * It gives birth to immature young, as the mother suckles its young from the nipples that are found inside a special pouch at the bottom of its abdomen where it keeps its young until they become fully grown. 	<ul style="list-style-type: none"> * It belongs to subclass Eutheria, order Primates. Or * It is a placental mammal which gives birth to a fully developed young, as the mother suckles its young from the milk that is secreted from the mammary glands.
The common character :	<ul style="list-style-type: none"> * Both of them belong to class Mammalia. Or * They are viviparous and have mammary glands that secrete milk to suckle their young. 	

"One difference and one common character are enough".

Answers | of Test Yourself Questions



Unit Three

Chapter One

Lesson 1

- 1 (1) (c) It has the smallest size in chromosomes.
(2) (b) (8).

- 2 (1) (c) (3).
(2) (a) (1).
(3) (d) (4).

- 3 (1) (b) The protein is just the gene expression about itself.
(2) (c) Skin cell / Sperm
(3) (a) homozygous pair of sex chromosomes.

Lesson 2

- 1 ① Answer by yourself.
② (1) (a) one type.
(2) (b) 50%
(3) (c) 50% (aa).
(4) (b) 235

- 2 (1) (b) 50%
(2) (b) 4

Chapter Two

Lesson 1

- 1 (1) 1. (c) (1), (2) & (4).
2. (b) 50%
3. (b) two genotypes.
4. (c) three phenotypes.
(2) (a) Black with black.

- 2 (1) (b) 50%
(2) (d) 100%

- 3 (b) B

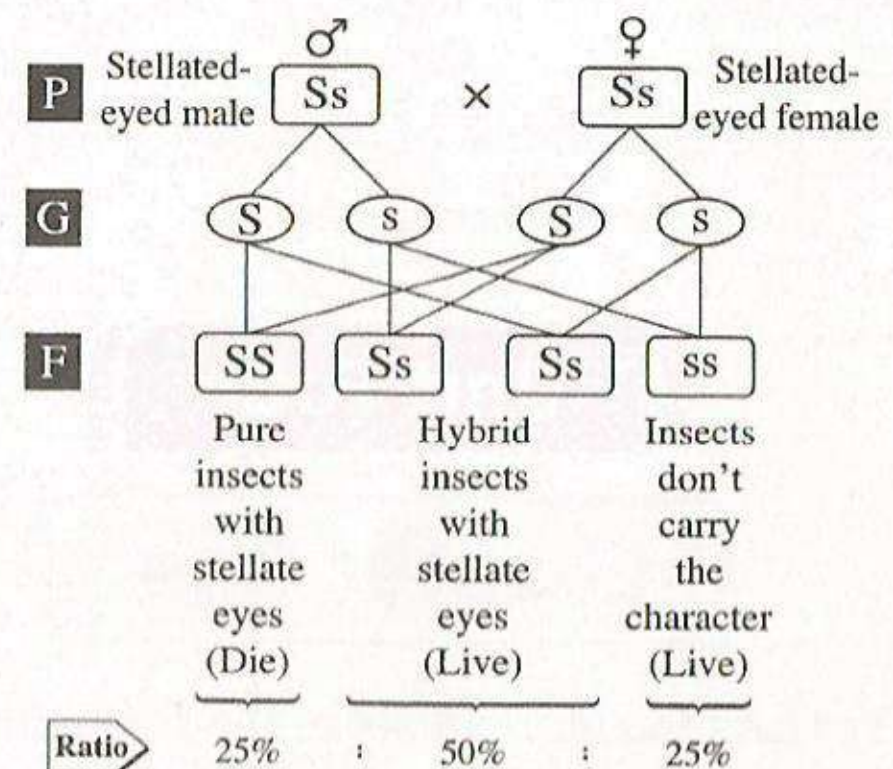
- 4 Answer by yourself.

- 5 ① (a) 0%
② Nadia / Because three pairs of genes that control the inheritance of Rhesus factor in the individual are recessive.

Lesson 2

- 1 (1) (c) $\frac{1}{16}$
(2) (a) 0%
(3) (d) L
(4) (a) $\frac{4}{16}$

- 2 ① • If we suppose that the gene of stellate (star) eyes character in *Drosophila* insect : S



∴ The dead insects represent $\frac{1}{4}$ of the resulted generation (25%) / Due to the gathering of a pair of pure lethal dominant genes together.

- 2 (d) 75%

- 3 ① Severe decrease in temperature of the surrounding (severe cold).
② Because these parts are exposed directly to the severe cold for long periods of time.
③ Due to the presence of the environmental factor (severe cold) that is needed by the gene of the black colour character for fur to express itself. So, the black colour appears instead of the white colour when exposed to an ice-bag for long periods of time.

Chapter Three

Lesson 1

- 1 ① Answer by yourself.
② (a) Hormones.
(b) Testes.

- 2 (1) (b) a male with Klinefelter's syndrome.
(2) (d) a female with Turner's syndrome.
(3) (c) a normal female.
(4) (a) a normal male.

Lesson 2

1. (b) 50%
2. (1) 1. (a) 0%
2. (a) 100%
(2) 1. (b) 25%
2. (c) 50%
3. (d) 100%
4. (b) The appearance of the beard is affected by the male sex hormones.

Unit Four

Chapter One

1. Yes / As the individuals of the first generation (C) that is resulted from the crossing of plants (A) and (B) is totally similar to the morphological features of the parents, as they are fertile and have the ability to reproduce one more time.
2. (1) (c) *Pan troglodytes*.
(2) (a) *Tilapia nilotica*.
3. Felidae family belongs to order Carnivora.
4. (b) (2).

Chapter Two

Lesson 1

1. (b) Aristotle.
2. (1) (c) It needs sunlight to continue its life.
(2) Answer by yourself.
3. (1) (b) (Z).
(2) (c) (X) and (Y) together.
4. (1) 1. (c) *Euglena*.

2. (b) *Nostoc*.

3. (d) *Trypanosoma*.

(2) (d) unicellular and eukaryotic.

5. (b) *Amoeba*.

Lesson 2

1. (1) (b) The first statement is wrong and the second statement is correct.
(2) (b) the hyphae shape.
2. (1) Answer yourself.
(2) (1) • Organism (A) is Dinoflagellate.
• Organism (B) is *Polysiphonia*.
(2)

Organism (A)	Organism (B)
Belongs to kingdom Protista.	Belongs to kingdom Plantae.

3. (1) (b) *Adiantum*.
(2) 1. (d) (4).
2. (a) (1).
3. (b) (2).
4. (c) (3).

Chapter Three

Lesson 1

1. (d) the complexity degree of the body.
2. (b) predation.
3. (1) (a) kingdom.
(2) (d) It is a parasitic animal.
4. (b) the method of respiration.
5. (d) unsegmented and movable body.

Lesson 2

1. • Organism (A) : fish, amphibians and reptiles.
Because these organisms are cold-blooded animals which can't regulate their body

temperature, where it changes according to the change in the surrounding environment, as they acquire their temperature from this environment.

- **Organism (B)** : birds and mammals.

Because these organisms are warm-blooded animals that their body temperature doesn't change a lot with the change of the environment temperature and they use the food energy to keep their body temperature constant.

② (1) (b) paired fins.

(2) (a) The first statement is correct and the second statement is wrong.

③ (1) *Answer by yourself.*

(2) (b) it is from the warm-blooded animals.

④ (c) Amphibia.

⑤ • Class Osteichthyes has an air bladder that helps them in swimming and floating.

• Class Aves has air sacs which are used as storehouses for the additional amounts of air, to help them in breathing during flying.

⑥ (1) Class Mammalia.

(2) (c) The skin is covered by hair.

⑦ (d) Kangaroo.

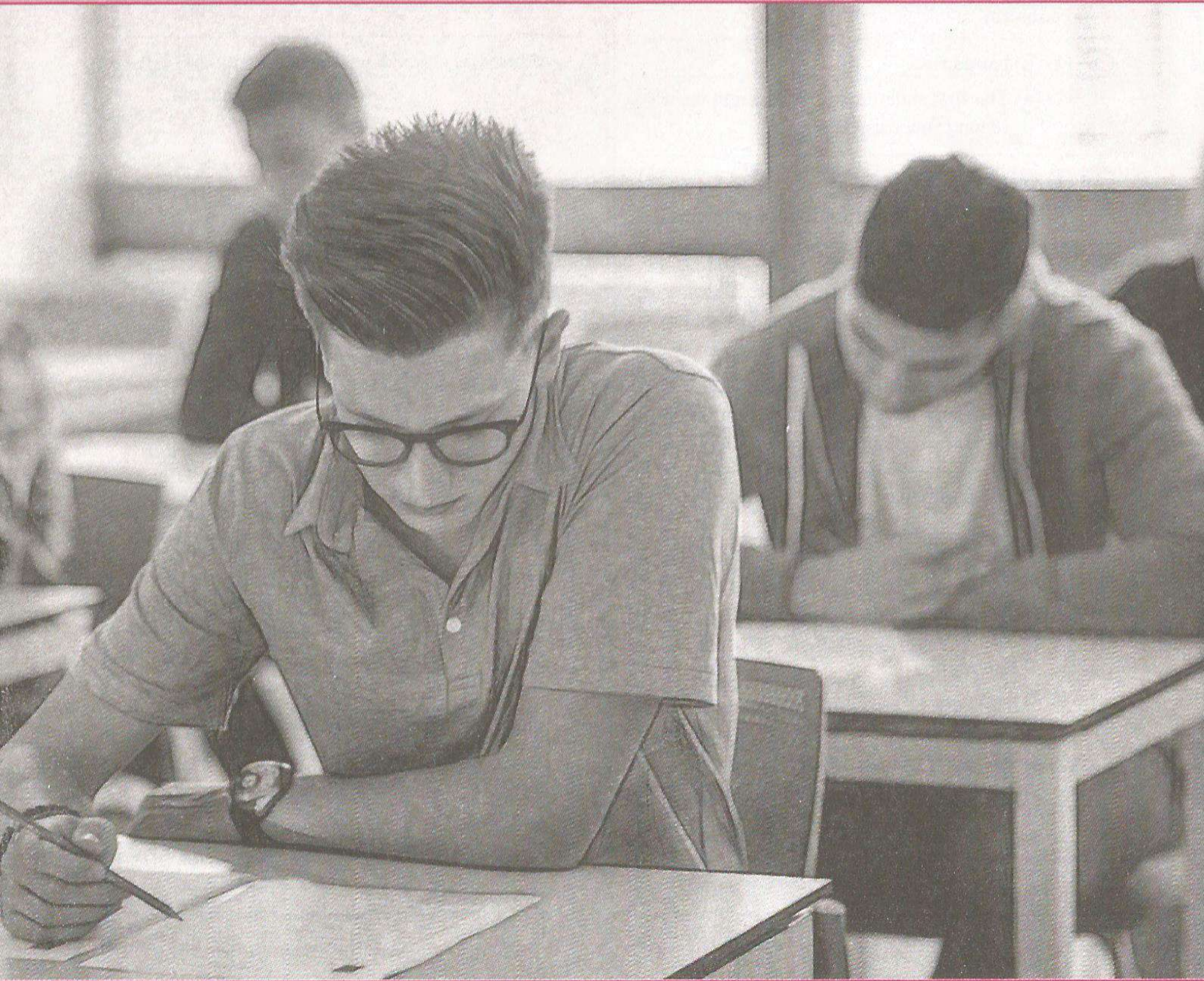
⑧ (1) • **Organism (X)** : Rabbit / Order Lagomorpha.

• **Organism (Y)** : Rat and gerbo / Order Rodentia.

(2) • Organism (X) has a short tail and large ear.

• Organism (Y) has a long tail and short ear.

Answers | of 10 Model Exams

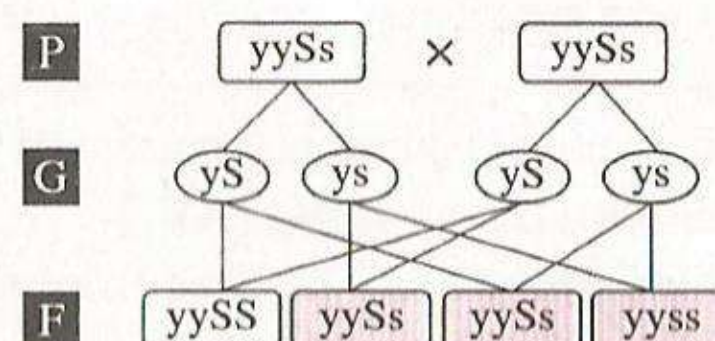


Answers of Model Exam 1

- 1 (d) The sperm and the ovum are responsible for the sex determination.
- 2 (a) animal (Y) is from the same family.
As the organisms (X) and (Y) belong to the same genus (*Panthera*), but they differ in species. So, the animals (X) and (Y) must belong to the same family.
- 3 (b) Both parents are hybrid long-winged.
- 4 (c) it forms spores inside sporangia.
- 5 (d) six genes.
- 6 (d) malaria *Plasmodium*.
- 7 (b) the number of phenotypes.
As in case of the inheritance of dominant lethal genes, all the individuals resulted from crossing of hybrid parents with two phenotypes (as in the inheritance of yellow fur colour character in mice), while in case of the inheritance of recessive lethal genes, all the individuals resulted from crossing of hybrid parents with one phenotype only (as in the inheritance of chlorophyll absence character in corn plant).
- 8 (d) Mule is produced from their mating.
- 9 (d) a female gamete that results in an abnormal individual.
- 10 (c) embryonic stage of salamander.
As the embryonic stages of amphibians as salamander breathe the atmospheric air by gills, because they live in water.
- 11 : 15 Answer by yourself.
- 16 (a) • The genotype of F_1 is : Yy
• The genotypes of F_2 are : YY, Yy & yy
(b) As the number of the resulted individuals in the second generation is 1500 plants with yellow seeds and 492 plants with green seeds, which means that the ratio is 3 with yellow seeds : 1 with green seeds approximately. So, this belongs to the law of segregation of genetic factors (Mendel's first law) that explains the inheritance of a pair of allelomorphic characters.
- 17 Answer by yourself.

Answers of Model Exam 2

- 1 (c) the location of chromosomes in each of them.
As the chromosomes are found in the nucleus of the somatic cells and the gametes of the living organism.
- 2 (c) class.
- 3 (b) the protein that is responsible for the appearance of a certain genetic character.
- 4 (b) yeast.
- 5 (d) (4) and (5).
As the genotype of plant no. (2) is ($yySs$), when crossing it with another plant having the same genotype, the individuals were resulted as follows :



∴ Some resulted individuals with the genotypes identical to the individuals no. (4) & (5).

- 6 (b)
- 7 (a) (AB^+).
As the blood group (AB^+) contains antigens (A) and (B) and the antigens of the Rhesus factor (Rh^+), but it is free from the two types of antibodies (anti-a) and (anti-b).
- 8 (d) the presence of exoskeleton.
- 9 (c) the convergence of a dominant gene from each pair of the two pairs of genes.
- 10 (c)
- 11 As the haemophilia and colour blindness are from the sex-linked traits in human, where the genes of the character are located on the sex chromosome (X) and this chromosome is found in both male and female.
- 12 & 13 Answer by yourself.
- 14 (a) * Blood group : (B).
* Rhesus factor : negative (Rh^-).

- (b) * Blood group : (A).
* Rhesus factor : positive (Rh^+).

15 & 16 Answer by yourself.

- 17 (a) • (X) : male donkey.
• (Y) : female horse.
• (Z) : mule.
(b) No / Because the mule is resulted from the mating between two different species (female horse with male donkey), therefore it is infertile (sterile) and is not able to mate, reproduce and produce a new offspring of the same species.

Answers of Model Exam 3

- 1 (d) (8) and (23).
2 (C) genus and species.
3 (b) Blood group (O^+) can be transfused to a sick person with blood group (AB^-).
As the blood group (AB^-) is free from the Rhesus antigens. So, when transfusing a blood with blood group (O^+) to a sick person with blood group (AB^-), this causes the stimulation of his immune system to produce antibodies that act on breaking down the RBCs. So, it can't be transfused the blood group (O^+) to the blood group (AB^-).
4 (C)
5 (b) a female with Turner's syndrome.
6 (C) (3).
As the structure no. (3) is oral groove that is used by *Paramecium* in nutrition.
7 (d) SsYy
8 (b) parasitism decreases and the free-living character increases.
As most of flatworms are parasitic and a few is free-living, while some of roundworms are free-living in water or mud and the others parasitize the human, animals and plants, but the majority of ringworms are free living in sea, fresh water or the muddy soils and a few is external parasites. So, as we move from phylum Platyhelminthes to phylum Nematoda till reaching phylum Annelida, we find that the parasitism decreases and the free-living character increases.

- 9 (d) the presence of chlorophyll gene and exposure to the light.

As the formation of chlorophyll gene is affected by a genetic factor knowing as the presence of chlorophyll gene and also affected by an environmental factor that is the light.

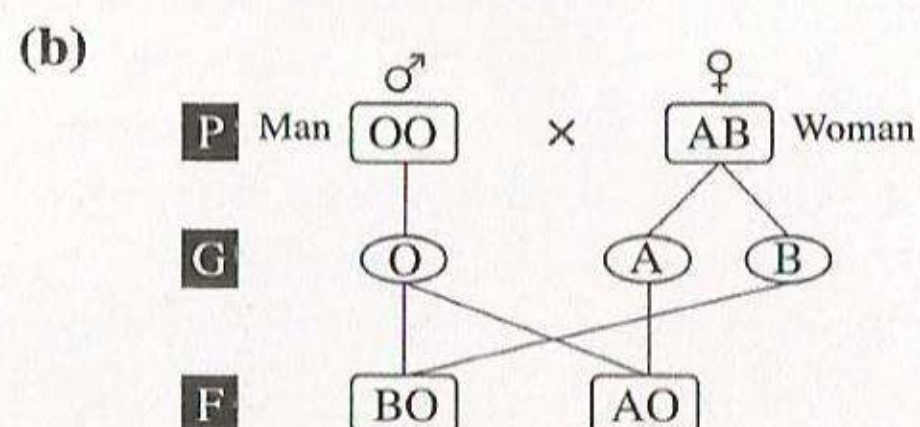
10 (C) *Hydra*.

11 : 13 Answer by yourself.

- 14 The allelomorphic characters that disappear from the first generation and appear in the second generation express the case of lack of dominance.

15 & 16 Answer by yourself.

- 17 (a) * X_2 : Blood group (A).
* Y_1 : Blood group (B).



∴ The possibility of the appearance of blood group (X_1) "O" among children is : 0%

Answers of Model Exam 4

- 1 (C)
As the resulted nucleus contains two sets of homologous chromosomes in a diploid form.
2 (d) spiny ant-eater / kangaroo / squirrel / monkey.
3 (d) (A) and (B) genes are on the same chromosome.
As in the independent assortment of genetic factors law, each gene is located on a separate chromosome. So, the assortment of genes that are carried on the chromosomes in gametes is independent.
4 (C) *Aurelia*.
5 (a) 0%

6 (C) 63

As the mule is resulted from the fertilization of an ovum from a female horse containing 32 chromosomes with a sperm from a male donkey containing 31 chromosomes. So, the number of chromosomes in the somatic cells of mule is 63 chromosomes.

7 (a) ARh⁺

As when adding (anti-a) on a drop of blood, the agglutination takes place and it is not occurred when adding (anti-b). So, it is confirmed that the blood drop contains antigens (A) and doesn't contain antigens (B), so that the blood group is (A). Besides, when adding (anti-d) on the blood drop, the agglutination takes place, confirming that the blood drop contains Rh antigens (Rh⁺). Therefore, the blood group is (ARh⁺).

8 (C) complementary genes.

9 (b) the type of reproduction.

10 (d) the father suffers from the baldness.

As the baldness character in males appears, due to the presence of two dominant genes (B⁺B⁺) or the presence of one dominant gene (B⁺B). So, the appearance of a pure bald male in the offspring is confirmed that the father suffers from the baldness.

11 : 16 Answer by yourself.

17

	Genotypes	Phenotypes
(1)	BbX ^c X ^c	Brown-eyed female suffering from the colour blindness.
(2)	bbX ^c X ^c	Blue-eyed female suffering from the colour blindness.
(3)	BbX ^c Y	Healthy brown-eyed male.
(4)	bbX ^c Y	Healthy blue-eyed male.

Answers of Model Exam 5

1 (d) (2) only.

2 (d) greater numbers of organisms that share less common traits than the following group.

As the levels of the living organisms classification shows that each group comprises greater numbers of organisms that share in less common traits than the following group, for example the kingdom includes a greater number of organisms that share in less common characteristics than the phylum and so on with the other levels of the taxonomic hierarchy.

3 (C)

As the mother that needs antiserum has negative Rhesus factor (Rh⁻), i.e. she contains all genes of Rhesus factor in a recessive form.

4 (d)

5 (b) 1 : 2 : 1

6 (a) diatoms and sponge.

7 (a) B⁺B^cX^cY × B⁺B^cX^cX^c

8 (C)

As *Riccia* is a flat plant belonging to the phylum Bryophyta (Mosses) that belong to non-vascular plants which don't contain vascular tissues specialized in transporting water or food, such as xylem tissue.

9 (b) sex-linked

10 (a) (X) is from cold-blooded animals and (Y) is from warm-blooded animals.

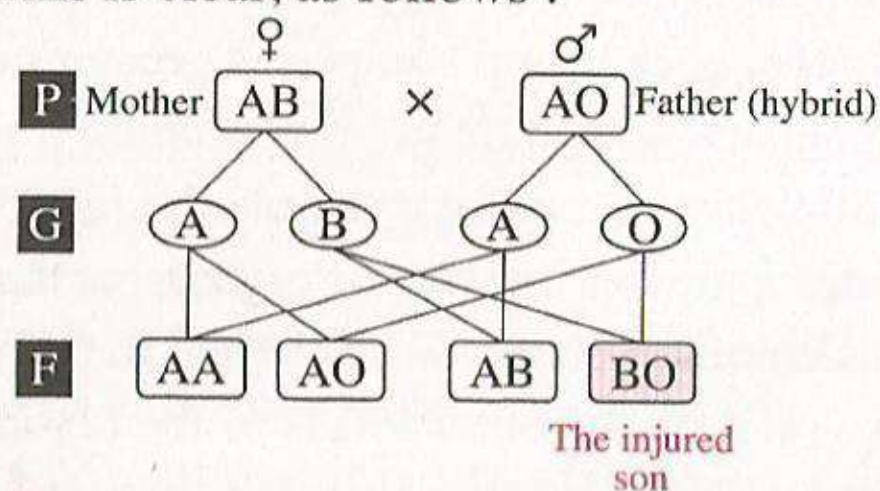
As the thermal range for animals (X) is greater. So, their body temperature changes according to the change of the surrounding environment temperature, this occurs in cold-blooded animals, while the thermal range for animals (Y) is small, so that their body temperature doesn't change with the change of the surrounding environment temperature, therefore they are called warm-blooded animals.

11 : 14 Answer by yourself.

15 ∴ The father has blood group (AO) "no. (2)" and the mother has blood group (AB) "no. (3)".

∴ The injured son has blood group (BO). So, he can't receive blood from his father (A) or his mother (AB).

This is clear, as follows :



∴ The blood groups that can be transfused to the injured son are : (B) and (O).

16 Answer by yourself.

17 Mule.

Answers of Model Exam 6

1 (b) Hybrid brown.

As the appearance of both dominant and recessive characters among children (brown and blue eyes colour) with the presence of a recessive character in the mother (blue eyes colour) confirmed that the father carries the genes of the character in a hybrid form. So, the colour of the father's eyes is hybrid brown according to Mendel's laws.

2 (b) *Nostoc*.

3 (d) studying the characteristics of chromosomes.

4 (c) contains rhizoids.

5 (c) all the daughters are healthy.

As the colour blindness character is sex-linked trait to be appeared in females, the gene of the character must be present on both sex chromosomes (XX). So, when crossing a colour-blinded woman ($\overset{c}{X}\overset{c}{X}$) with a healthy man ($\overset{C}{X}Y$), it is confirmed that all daughters are healthy ($\overset{C}{X}\overset{c}{X}$), but they are carriers.

6 (a) bread mould

7 (c) green seedlings of the corn plant.

As the inheritance of chlorophyll absence character in corn plant is from recessive lethal genes, that causes the growing of some seedlings free from chlorophyll (white-coloured), due to the presence of a recessive lethal gene in the pure form (cc), as the gene of chlorophyll presence (C) dominates over the gene of chlorophyll absence (c). So, the green colour of

corn plant seedlings appears with genotypes (CC or Cc) "pure or hybrid dominant", therefore the phenotype doesn't express the genotype.

8 (c) Artiodactyla.

9 (a) are found on one pair of chromosomes.

As in the law of independent assortment of genetic factors, the assortment of genes that are carried on the chromosomes in gametes is independent, because each gene is located on a separate chromosome, while in the inheritance of Rhesus factor, the genes of the character are located on one pair of chromosomes.

10 (b)

11 The grandson inherits this disease from the second family / As the father who suffers from this disease in the first family doesn't pass the gene of the disease to the sons. So, the genotype of the son no. (1) is ($\overset{H}{X}Y$), while the mother in the second family is a gene carrier, she passes the gene to the daughters and sons. Therefore, the genotype of the daughter no. (2) is ($\overset{H}{X}\overset{h}{X}$). Thus, the grandson inherits the gene of the disease from his mother in the second family.

12 : 17 Answer by yourself.

Answers of Model Exam 7

1 (c) red blood corpuscles.

2 (d) *Polypodium*.

3 (b) 100

As the percentage of the resulted generation from the crossing of two individuals having a heterozygous pair of genetic traits is 50% of individuals with hybrid dominant genotype. Therefore, the number of heterozygous plants when a crossing occurs between two hybrid green pea plants is about 100

4 (c) All mammals have canines.

5 (d)

6 (b)

7 (b) 2 : 1

As the number of phenotypes for the dominant lethal genes is two phenotypes (as in the inheritance of yellow fur colour character in

mice, where the genotype of yellow mice is (Yy) and the genotype of grey mice is (yy)), while the number of phenotypes for the recessive lethal genes is one phenotype only (as in the inheritance of chlorophyll absence character in corn plant, where the genotype of the green seedlings is (CC) and (Cc)).

8 (C) method of respiration.

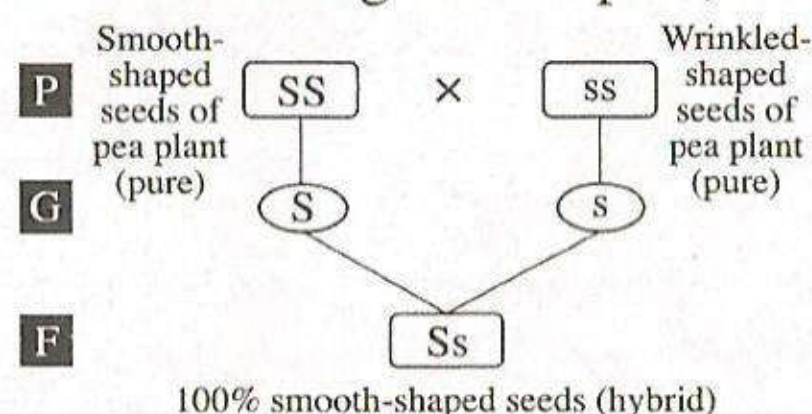
9 (C) sex-limited

10 (C) Echinodermata.

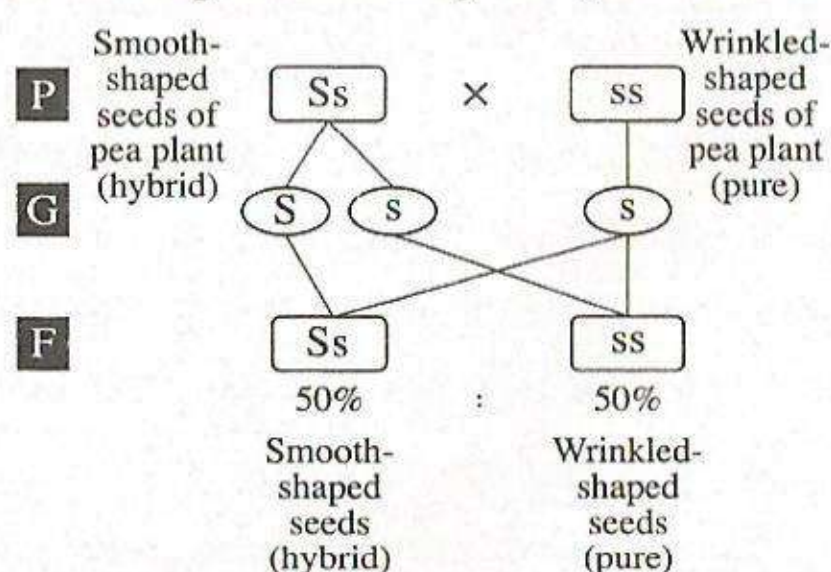
11 * By crossing this plant with another one has wrinkled-shaped seeds (it is a recessive trait which is always pure).

* If the result is :

(a) 100% smooth-shaped seeds. So, the plant that we are asking about is pure, as follows :



(b) 50% smooth-shaped seeds and 50% wrinkled-shaped seeds. So, the plant that we are asking about is hybrid, as follows :



12 As the father's blood group (A) is hybrid (AO) and the mother's blood group (B) is hybrid (BO), where their (Rh) factor is hybrid positive. So, they can give birth to a child with blood group (O).

13 : 17 Answer by yourself.

Answers of Model Exam 8

1 (b) $Tt \times tt$

2 (C) *Nostoc* / diatoms / *Riccia* / *Polypodium*.

3 (d) 44 chromosomes and 22 chromosomes. As the nucleus of the somatic cell in human

contains 46 chromosomes (2n), "i.e. it contains 46 molecules of DNA", while the nucleus of male gamete contains 23 chromosomes (n), "i.e. it contains 23 molecules of DNA".

4 (b) are formed of segmented hyphae.

5 (b) lack of dominance.

6 (c)

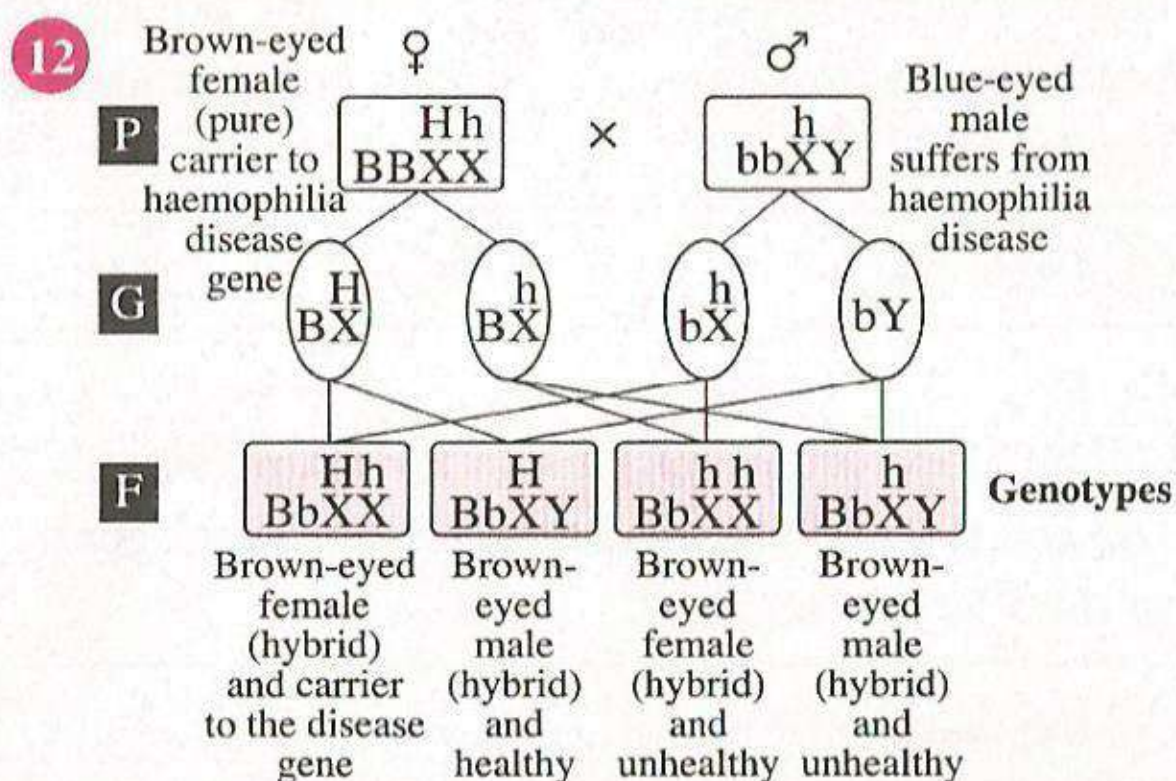
7 (d) (AO) and (BO).

8 (d) The flowers of the plants of figure no. (2) have trimerous floral whorls or their multiplies. As the plants of figure no. (2) are monocotyledonous plants whose flowers are characterized by trimerous whorls or their multiplies.

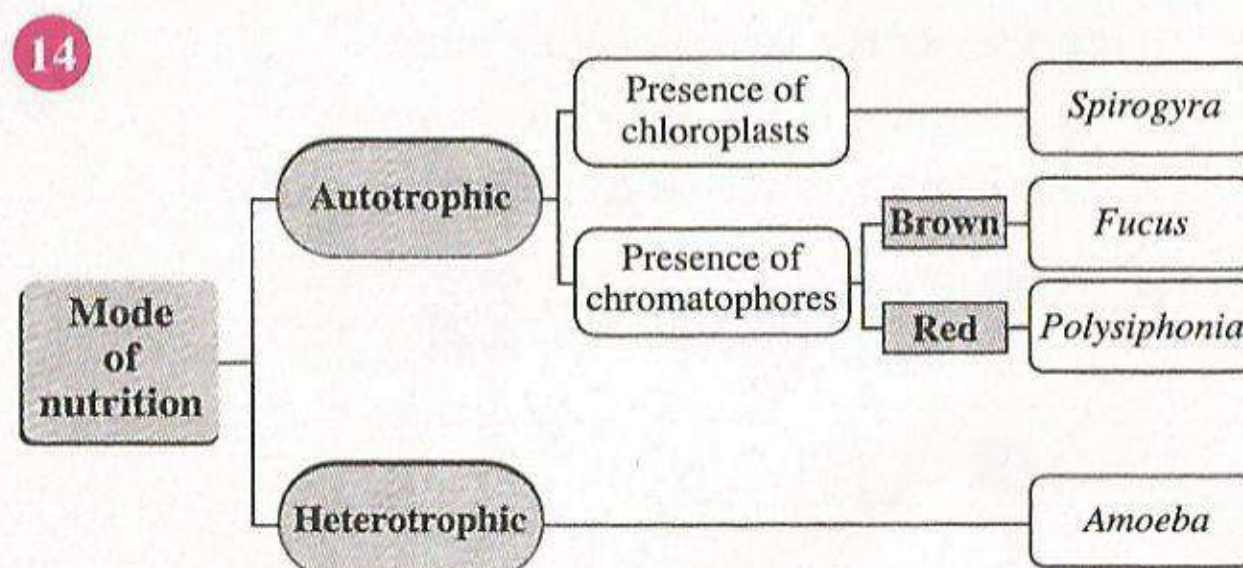
9 (a) Baldness.

10 (C)

11 Answer by yourself.



13 Answer by yourself.



15 & 16 Answer by yourself.

17 (a) * The genotypes of the parents are : AaBb (male) and AaBB (female).

* The genotypes of the offsprings :

- (1) AABb (2) AaBB
(3) AaBb (4) AaBB
(5) aaBB

(b) Answer by yourself.

Answers of Model Exam 9

1 (c) a female with Turner's syndrome.

2 (c) Order.

3 (b) 19

As the ovum (gamete) contains half the number of chromosomes that is found in the somatic cells (white blood cell) in a single form.

4 (d) Sponges.

5 (d) 0%

6 (d) lily.

7 (c) 50%

As the individual with genotype (AaBb) gives 4 types of gametes (AB), (Ab), (aB) and (ab). So, the percentage of the gametes carrying one dominant gene only is 50%

8 (c) Diatoms.

9 (b) O⁻

As the blood group (O⁻) doesn't contain antigens (A) and (B) and also doesn't contain the antigens of the Rhesus factor.

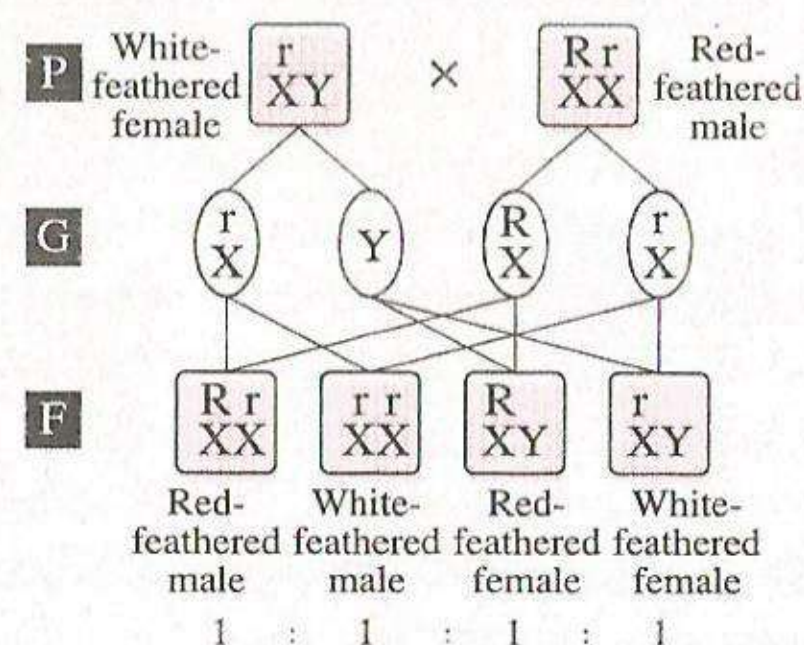
10 (c) the number of toes.

11 * This case represents sex-linked traits.

* (R) represents the red colour gene and (r) represents the white colour gene.

∴ The female is the sex determinant.

∴ The female is XY and the male is XX



12 Because *Nostoc* is from prokaryotes, where its genetic material is found in the cytoplasm and not surrounded by a nuclear membrane from outside, as well as its cell wall is devoid of cellulose or pectin and the cytoplasm is devoid of many membranous organelles, so that it belongs to kingdom Monera, while *Euglena* is from eukaryotes, where its genetic material is surrounded by a nuclear membrane that separates it from the cytoplasm, as well as it moves by flagella, so that it belongs to kingdom Protista.

13 : 17 Answer by yourself.

Answers of Model Exam 10

1 (b) 2 : 1

2 (c) preceding the order and following the phylum.

3 (a) 3 : 1

4 (d) *Nostoc*.

5 (a) normal male.

6 (c) *Polysiphonia*.

7 (d) (AB).

As the blood group of the father (O) represents complete dominance case and it is considered the recessive character. So, the genotype is always pure (OO), when the crossing occurs with a person that has any other blood group, the resulted generation inherited the gene (O), and so the genotypes of the resulted blood groups are (AO), (BO) and (OO) only.

8 (c) *Aurelia*.

9 (d) sons.

As the gene of colour blindness is carried on the sex chromosome (X) and this chromosome is passed from the father to the females (daughters) only, but the males (sons) inherit the sex chromosome (Y) from the father that doesn't carry the gene of the colour blindness character.

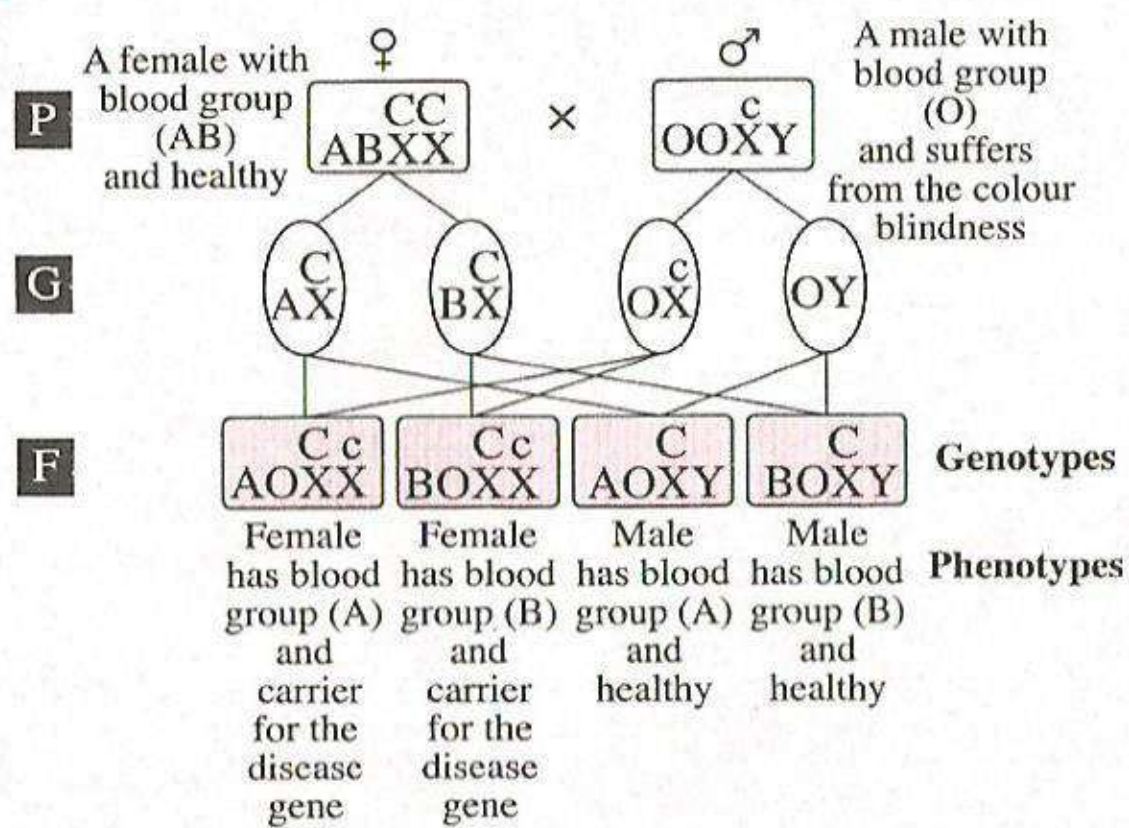
10 (b) dolphins.

11 & 12 Answer by yourself.

13 The infantile dementia disease is a genetic disease causing the death of 25% of the generation that is resulted from crossing two healthy parents and they gave birth to a son with infantile dementia. If the recessive genes are converged together. So, the parents must be carriers for the disease gene.

14 Answer by yourself.

15



16 & 17 Answer by yourself.